AUGUST 1949

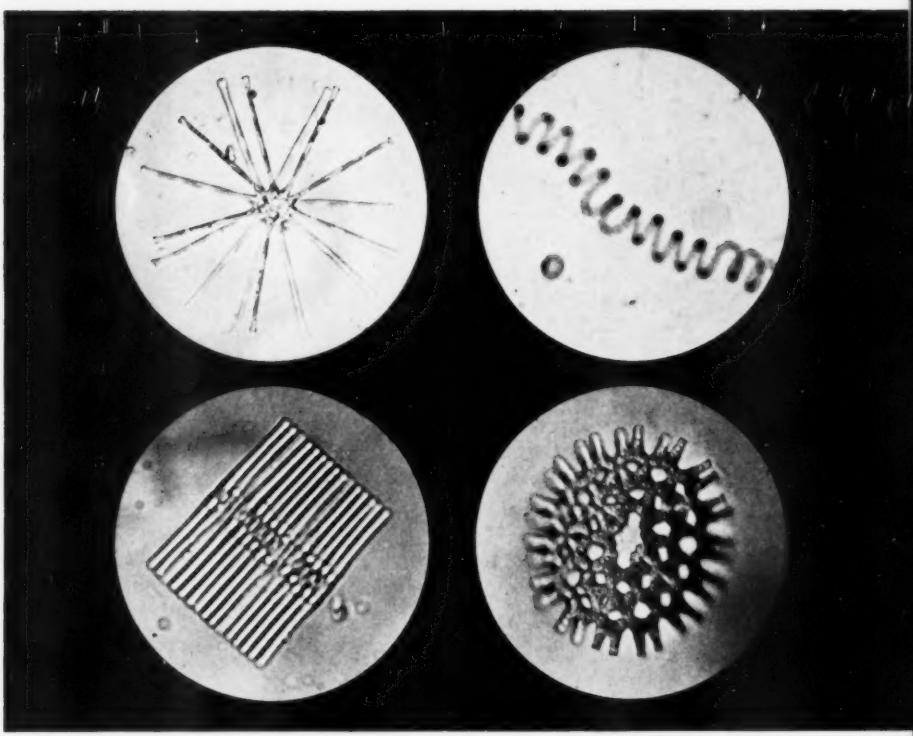
Journal

AMERICAN WATER WORKS ASSOCIATION

VOL. 41 • NO. 8

Asterionella (300X)

Anabaena (105X)

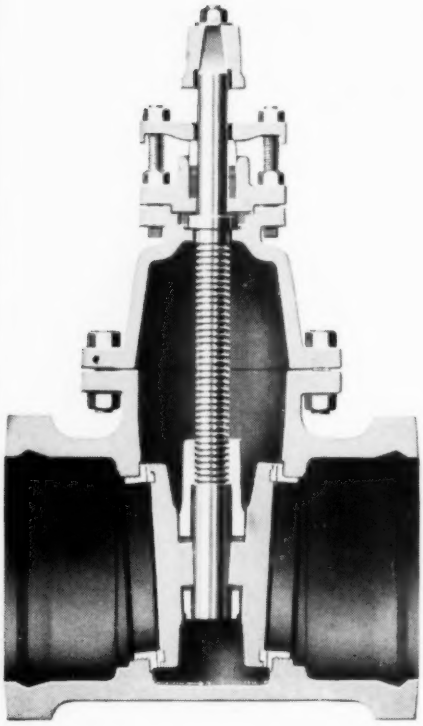


Synedra (400X)

Pediastrum (400X)

Fearsome Foursome of August Algae

R. D. WOOD GATE VALVES stand on their RECORD



● GATE VALVES are buried deep underground and too often forgotten—and yet, if the critical day comes, they *must* not fail.

The record of R. D. Wood Gate Valves inspires confidence. They have been demonstrating their reliability for generations—proving the soundness of their design. Only three moving parts—spreader and two discs. The discs are free to rotate their full circumference when raised and lowered—are not subject to wear at any one point. In closing, pressure is applied from the center, the discs seating tightly and without distortion. There are no pockets to collect sediment. Fully opened, the valve permits an unobstructed flow of water.

For the safety of your community, specify R. D. Wood Gate Valves, the gate valves with the record of dependability. Send for complete information today.

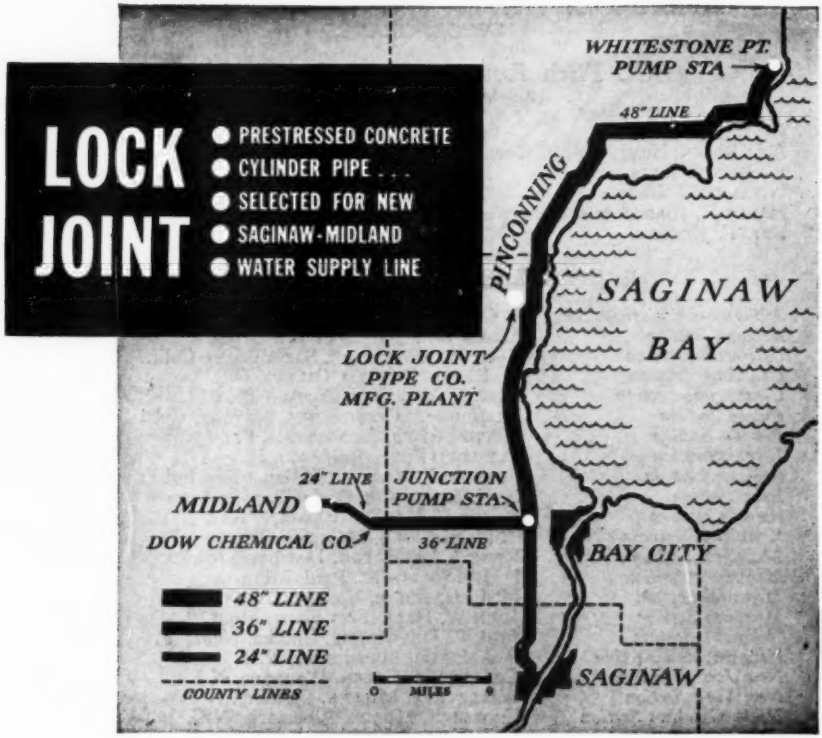
Seasoned castings. Rigidly inspected. For working pressures up to 175 lbs. Tested to 300 lbs. Conforming to AWWA specifications. Bell or flanged ends, or to connect with any standard type of joint. Sizes 2" to 30".

Be extra safe. Operate all valves at least once a year.

R. D. WOOD COMPANY

Public Ledger Building, Independence Square
Philadelphia 5, Pa.

Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (Centrifugally Cast in Sand Molds)



ONCE AGAIN, Lock Joint Prestressed Concrete Cylinder Pipe has been selected for a major water works project.

SPECIFICATIONS issued by the Saginaw-Midland Water Supply Commission call for the manufacture and installation of 254,500 feet of 48 inch pipe . . . 143,230 feet of 36 inch pipe . . . 14,900 feet of 24 inch pipe . . . all operating at a pressure of 130 pounds.

WHEN COMPLETED, this 78 mile water supply line will be capable of delivering 23 MGD to the city of Saginaw and 20 MGD to Midland.

BY SELECTING Lock Joint Prestressed Concrete Cylinder Pipe, the Saginaw-Midland Water Supply Commission assures itself of a pipe line of maximum elasticity, permanent high carrying capacity and an estimated life of one hundred years or more.

LOCK JOINT PIPE COMPANY

Established 1905

P. O. BOX 269, EAST ORANGE, NEW JERSEY

Denver, Colo. • Chicago, Ill. • Kenilworth, N. J. Kansas City, Mo. • Rock Island, Ill. • Joplin, Mo. Valley Park, Mo. • Cleveland, Ohio • Hartford, Conn. • Navarre, Ohio

SCOPE OF SERVICES—Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains in a wide range of diameters as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous lines.

LOCK JOINT
Reinforced Concrete
PRESSURE PIPE

AMERICAN WATER WORKS ASSOCIATION
INCORPORATED

500 Fifth Avenue, New York 18, N.Y.
(Telephone: LAckawanna 4-2290)

A. P. BLACK, Head, Dept. of Chemistry, Univ. of Florida, Gainesville, Fla. *President*
W. VICTOR WEIR *Vice-President*
WILLIAM W. BRUSH *Treasurer*
HARRY E. JORDAN (*Residence phone:* POrt Washington 7-2441) *Secretary*
ERIC F. JOHNSON *Asst. Secretary*

Board of Directors

Alabama-Mississippi Sec.	A. CLINTON DECKER, Birmingham, Ala.	to 1950
Arizona Section	ALDEN W. MILLER, Phoenix, Ariz.	–1950
California Section	CARL M. HOSKINSON, Sacramento, Calif.	–1951
Canadian Section	W. E. MACDONALD, Ottawa, Ont.	–1952
Chesapeake Section	CARL A. HECHMER, Hyattsville, Md.	–1951
Cuban Section	LEANDRO DE GOICOECHEA, Havana, Cuba	–1951
Florida Section	DAVID B. LEE, Jacksonville, Fla.	–1951
Illinois Section	CLIFFORD FORE, Robinson, Ill.	–1951
Indiana Section	EDWARD F. KINNEY, Indianapolis, Ind.	–1952
Iowa Section	H. F. BLOMQUIST, Cedar Rapids, Iowa	–1952
Kansas Section	MAJOR C. HAGAR, Lawrence, Kan.	–1952
Kentucky-Tennessee Sec.	C. M. MCCORD, Memphis, Tenn.	–1950
Michigan Section	RENE J. LA MARRE, Dearborn, Mich.	–1950
Minnesota Section	D. B. MORRIS, St. Paul, Minn.	–1951
Missouri Section	M. P. HATCHER, Kansas City, Mo.	–1952
Montana Section	JOHN W. HALL, Fort Shaw, Mont.	–1951
Nebraska Section	JOHN C. DETWEILER, Omaha, Neb.	–1950
New England Section	P. A. SHAW, Manchester, N.H.	–1950
New Jersey Section	CHARLES H. CAPEN, Wanaque, N.J.	–1950
New York Section	WALLACE T. MILLER, Ossining, N.Y.	–1950
North Carolina Section	GEORGE S. MOORE, Albemarle, N.C.	–1952
Ohio Section	L. T. FAWCETT, Youngstown, Ohio	–1951
Pacific Northwest Sec.	WALTER J. MOORE, Eugene, Ore.	–1950
Pennsylvania Section	MYRON G. MANSFIELD, Pittsburgh, Pa	–1950
Rocky Mountain Section	DANA E. KEPNER, Denver, Colo.	–1952
Southeastern Section	HENRY M. MATHEWS, Thomasville, Ga.	–1952
Southwest Section	M. B. CUNNINGHAM, Oklahoma City, Okla.	–1951
Virginia Section	H. E. LORDLEY, Richmond, Va.	–1952
West Virginia Section	T. J. BLAIR JR., Charleston, W.Va.	–1952
Wisconsin Section	WILLIAM U. GALLAHER, Appleton, Wis.	–1952
Manufacturer	DANIEL J. SAUNDERS, New York, N.Y.	–1952
Manufacturer	WILLARD F. ROCKWELL, Pittsburgh, Pa.	–1950
Manufacturer	WILLIAM J. ORCHARD, Newark, N.J.	–1951

Ex-Officio Members of the Board

President	A. P. BLACK, Gainesville, Fla.	–1951
Past-President	LINN H. ENSLOW, New York, N.Y.	–1950
Vice-President	W. VICTOR WEIR, University City, Mo.	–1950
Treasurer	WILLIAM W. BRUSH, New York, N.Y.	–1950
Ch. W. W. Practice Com.	LOUIS R. HOWSON, Chicago, Ill.	–1950
Ch. W. W. Admin. Com.	WENDELL R. LADUE, Akron, Ohio	–1950
Ch. Publication Com.	CHARLES H. CAPEN, Wanaque, N.J.	–1950

Journal A.W.W.A. is published monthly at Prince & Lemon Sts., Lancaster, Pa., by the Am. Water Works Assn., Inc., 500 Fifth Ave., New York 18, N. Y., and entered as second class matter Jan. 23, 1943, at the Post Office at Lancaster, Pa., under the Act of Aug. 24, 1912. Accepted for mailing at a special rate of postage provided for in Sec. 1103, Act of Oct. 3, 1917; authorized Aug. 6, 1918.

Copyright, 1949, by the American Water Works Association, Inc.

Made in United States of America

WITH WATER RATES FIXED

you can't afford to let your meters

DIE AN UN-NATURAL DEATH

COSTS WAY UP **REVENUE DOWN**

With present rates and operating costs, can you afford to lose as much as 30 to 40% of REVENUE that might be collected? Yet that is what you can lose, experience proves, when you neglect meters and fail to remove them for the tests and repairs that would quickly renew their youthful accuracy . . . for no meter need "die a lingering death" while you can get new parts that fit old models, as you can with Trident Meters.

The way long-neglected meters lose revenue is well illustrated by the experience of one water department. Out of a lot of 40 meters brought in from 9 residential streets for testing and repair, 36 would not even move on 1/4 gpm. And when you consider that 25% of all water flows through domestic meters at 1 gpm or less, you can readily see the losses permitted by "half-dead" meters. Consult your Trident Representative for advice on a testing and repair program.

TRIDENT WATER METERS

Tridents are simple, rugged and retain their high initial accuracy over many years of operation. Even after years on the line, new interchangeable parts fit old casings, make them "as good as new," at small expense. Thus Tridents are easily repaired to register at least 90% at ¼ gpm, the minimum acceptable performance for repaired domestic meters.

NEPTUNE METER COMPANY • 50 West 50th Street • NEW YORK 20, N.Y.
Branch Offices in Chicago, San Francisco, Los Angeles, Portland, Ore., Denver, Dallas, Kansas City, Louisville, Atlanta, Boston.
NEPTUNE METERS, LTD., Long Branch, Ont., Canada

DIVISION AND SECTION OFFICERS

Officers of the Divisions

Water Purification Division—Chairman, J. E. KERSLAKE; Vice-Chairman, H. E. LORDLEY; Secretary-Treasurer, R. L. DERBY; Directors, M. E. FLENTJE, H. O. HARTUNG, I. M. GLACE.

Water Resources Division—Chairman, L. W. GRAYSON; Vice-Chairman, H. E. HUDSON, JR.; Secretary-Treasurer, G. E. FERGUSON; Directors, RICHARD HAZEN, D. D. GROSS.

Water Works Management Division—Chairman, G. E. ARNOLD; Vice-Chairman, L. J. HOFFMAN; Secretary-Treasurer, PAUL WEIR; Directors, J. L. HAWKINS, M. B. CUNNINGHAM.

Officers of the Sections

*Section**	*Chairman*	*Vice-Chairman*	*Secretary-Treasurer*	*Past-Chairman*
Alabama-Miss.	B. F. Wade	G. H. Godwin	J. L. Snow	A. N. Beck
Arizona	A. A. Frederickson	G. W. Marx	Mrs. H. Rotthaus	J. F. Rauscher
California	L. W. Grayson	E. A. Reinke	H. C. Medbery	H. A. Price
Canadian	N. MacNicol		A. E. Berry	R. H. Martindale
Chesapeake	E. A. Schmitt	C. Gardner	C. J. Lauter	S. C. Blackburn
Cuban	L. V. Nunez	F. E. Zanetti	L. H. Daniel	J. Garcia Montes
Florida	W. W. Gillespie	S. K. Keller	A. E. Williamson	W. A. Glass
Illinois	H. R. Frye	J. C. Moomau	C. N. Brown	S. T. Anderson
Indiana	M. P. Crabill	J. Gordon	C. H. Bechert	C. E. Williams
Iowa	R. O. Ellis	G. Nelson	H. V. Pedersen	J. J. Hail
Kansas	A. B. Mawdsley	A. W. Rumsey	H. W. Badley	H. H. Kansteiner
Kentucky-Tenn.	Miss L. Sutherland	R. W. Williamson	R. P. Farrell	G. R. Kavanagh
Michigan	J. F. Dye	J. E. Cooper	R. J. Faust	P. Stegeman
Minnesota	H. G. Tischer	A. F. Mellen	R. M. Finch	W. D. Hurst
Missouri	J. F. Sanders	R. E. Piner	W. A. Kramer	R. C. Higgins
Montana	M. F. Dixon	M. E. Henderson	C. W. Brinck	J. B. Hazen
Nebraska	V. Livingston	C. W. Burdick	J. W. Cramer	G. E. Bell
New England	W. A. Gentner	D. C. Calderwood	R. H. Ellis	W. B. Duffy
New Jersey	P. S. Wilson	R. E. Bonyun	C. B. Tygert	E. D. Sheehan
New York	L. B. Smith	A. T. Luce	R. K. Blanchard	J. M. Wardle
North Carolina	R. W. Luther	E. R. Tull	E. C. Hubbard	W. M. Franklin
Ohio	T. R. Lathrop	A. A. Ullrich	F. P. Fischer	H. R. Kuhns
Pacific Northwest	B. C. Gosney	E. James	O. P. Newman	J. E. Morrison
Pennsylvania	E. J. Taylor	E. C. Goehring	L. S. Morgan	
Rocky Mountain	H. M. Krull	B. V. Howe	O. J. Ripple	G. A. Nisbet
Southeastern	T. A. Jones	J. F. Pearson	T. A. Kolb	W. R. Wise
Southwest	D. W. Robinson	J. R. Pierce	L. A. Jackson	G. H. West
Virginia	H. E. Silcox	E. C. Meredith	W. H. Shewbridge	M. J. Siebert
West Virginia	J. A. Sample	M. K. Jones	J. B. Harrington	D. H. Clark
Wisconsin	J. A. Snow	T. McGuire	L. A. Smith	V. A. Somers

* For Section's representative on the A.W.W.A. Board of Directors, see list on page ii.

"Maybe it's the water, Mary, better boil it."

THE virtual banishment of typhoid and other water-borne diseases, within the past 50 years, must be largely credited to those men responsible for the design, construction and operation of water supply systems. Modern water purification processes had their beginning only a few years before our Company was established in 1899. Today, (where necessary to make it safe), water is processed by over 5,000 of the more than 12,000 public water supply systems serving 85 million Americans.

The growth and progress of the gas industry and sanitation service during the past half-century has been equally remarkable. Today, over 20 million families use gas for cooking, refrigeration and space and water heating. More than half of our urban population is now served by 6,000 sewage treatment plants.

For 50 years, our Company has contributed to the growth and progress of these public services by providing cast iron pressure pipe for water, gas and sewer mains, and for water purification and sewage treatment plants. We have matched their progress with a half-century of progress of our own in manufacturing methods, production standards, quality controls and facilities for research and development.

To those responsible for the great progress in water supply, gas and sanitation service and their contribution to better health and living over the past fifty years, America pays tribute.

U.S. CAST IRON PIPE

1899-1949
U. S. Pipe & Foundry Co.
Makers for 50 years of cast iron pipe for water, gas and sewerage service.
General Offices: Burlington, N.J.

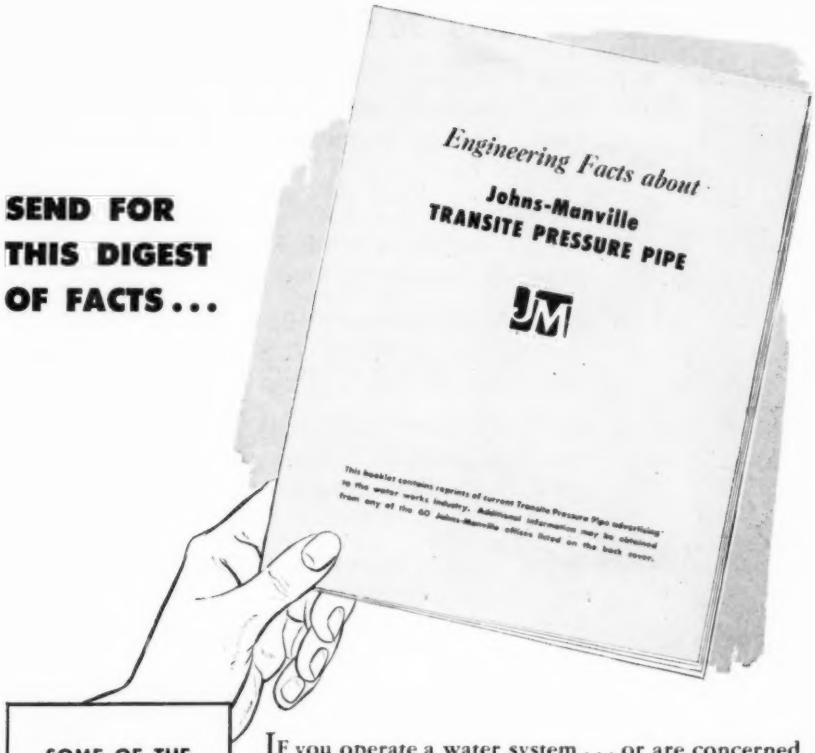
LIST OF ADVERTISERS

American Brass Co., The 75
American Cast Iron Pipe Co. ..... —
American Cyanamid Co., Industrial Chemicals Div. ..... —
American Pipe & Construction Co 29
American Well Works 63
Anthracite Equipment Corp ..... —
Armco Drainage & Metal Products, Inc. 5
Art Concrete Works ..... —
Atlas Mineral Products Co., The ..... —
Badger Meter Mfg. Co. ..... —
Barrett Div., The 73
Belco Industrial Equipment Div., Inc. ..... —
Bethlehem Steel Co. 69
Blakiston Co., The ..... —
Buffalo Meter Co. ..... —
Builders-Providence, Inc. 3
Calgon, Inc. 45
Carson-Cadillac Co. 8
Cast Iron Pipe Research Assn., The 20–21
Central Foundry Co., The 48
Centriline Corp 49
Chain Belt Co. 19
Chicago Bridge & Iron Co. 59
Clow, James B., & Sons ..... —
Dearborn Chemical Co ..... —
De Laval Steam Turbine Co. 57
Difco Laboratories ..... —
Dorr Co., The ..... Cover 3
Dowell Incorporated ..... —
Dresser Mfg. Div. ix
Economy Pumps, Inc. ..... —
Eddy Valve Co. ..... —
Electric Fish Screen Co. 34
Electro Rust-Proofing Corp. 42
Ellis & Ford Mfg. Co. 62
Everson Mfg. Corp 8
Fairbanks, Morse & Co. 31
Flexible Sewer-Rod Equipment Co. ..... —
Ford Meter Box Co., The 13
Fraser Utility Supply Co. ..... —
General Chemical Div., Allied Chemical & Dye Corp. 9
Greenberg's, M., Sons ..... —
Hayman, Michael, & Co., Inc. 12
Hays Mfg. Co. 17
Hellige, Inc. 68
Hersey Mfg. Co. 23
Hydraulic Development Corp. 65
Industrial Chemical Sales Division, West Virginia Pulp & Paper Co. x
Inertol Co., Inc. 4
Infilco, Inc. 43
Iowa Valve Co. ..... —
Johns-Manville Corp. vii
A. Johnson & Co. ..... —
James Jones Co. 41
Keasbey & Mattison Co. 39
Kennedy Valve Mfg. Co., The ..... —
Klett Mfg. Co. 56
Koppers Co., Inc. 51
Kupferle, John C., Foundry Co. 48
LaMotte Chemical Products Co. ..... —
Layne & Bowler, Inc. 33
Leadite Co., The ..... Cover 4
Lock Joint Pipe Co. i
Ludlow Valve Mfg. Co. ..... —
M & H Valve & Fittings Co. 67
Mabbs Hydraulic Packing Co. ..... —
Mueller Co. ..... —
National Cast Iron Pipe ..... —
National Water Main Cleaning Co. 15
Neptune Meter Co. iii
Northern Gravel Co. 68
Northrop & Co., Inc. 72
Omega Machine Co. (Div., Builders Iron Fdry.) 61
Peerless Pump Div. ..... —
Permutit Co. 37
Phelps Dodge Refining Corp. ..... —
Philadelphia Gear Works, Inc. 74
Photovolt Corp. 52
Pittsburgh-Des Moines Steel Co. 53
Pittsburgh Equitable Meter Div. (Rockwell Mfg. Co.) 84
Pollard, Jos. G., Co., Inc. 40
Portland Cement Assn. 71
Proportioneers, Inc. 81
Reilly Tar & Chemical Co. ..... —
Rensselaer Valve Co. 55
Roberts Filter Mfg. Co. ..... —
Ross Valve Mfg. Co. ..... —
Simplex Valve & Meter Co. ..... —
Smith, A. P., Mfg. Co., The 35
Solvay Sales Div., Allied Chemical & Dye Corp. 46
Sparling, R. W. 12
Standard Pipeprotection, Inc. 79
U. S. Pipe & Foundry Co. v
Virginia Smelting Co. ..... —
Walker Process Equipment, Inc. 11
Wallace & Tiernan Co., Inc. ..... xii, 47
Warren Foundry & Pipe Corp. 83
Well Machinery & Supply Co. 77
Welsbach Corp., Ozone Processes Div. ..... —
Wood, R. D., Co. ..... Cover 2
Worthington-Gamon Meter Co. 7

Directory of Professional Services—pp. 24-27

Albright & Friel, Inc.
Alvord, Burdick & Howson
Behrman, A. S.
Black & Veatch
Clinton L. Bogert Assoc.
Bowe, Albertson & Assoc.
Buck, Seifert and Jost
Burgess & Niple
Burns & McDonnell Eng. Co.
Caird, James M.
Camp, Dresser & McKee
Chester, Engineers, The
Consoer, Townsend & Assoc.
De Leuw, Cather & Co.
Fay, Spofford & Thorndike
Fent, O. S.
Gannett Fleming Corddry & Carpenter, Inc.
Glace, Ivan M.
Greeley & Hansen
Havens & Emerson
Haydock, Charles
Hitchcock & Estabrook, Inc.
Horner & Shifrin
Hunt, Robert W., Co.
Jones, Henry & Schoonmaker
Knowles, Morris, Inc.
Leggette, R. M.
Roberto Meneses Hoyos & Co.
Metcalf & Eddy
Nutting, H. C., Co.
Parsons, Brinckerhoff, Hall & Macdonald
Malcolm Pirnie Engineers
Pitometer Co.
Purcell, Lee T.
Ripple & Howe
Rose, Nicholas A.
Russell & Axon
Sirrine, J. E., Co.
Stanley Eng. Co.
Stilson, Alden E. & Assoc.
Ward & Strand
Weston & Sampson
Whitman & Howard
Whitman, Requardt & Assoc.

SEND FOR THIS DIGEST OF FACTS...



SOME OF THE SUBJECTS COVERED IN THIS BOOK:

- Installation Economies
- Carrying Capacity
- The Simplex Coupling
- Making Service Connections
- Resistance to Corrosion —an Index of Long Life
- Case Histories
- Dimensions —and other useful data

IF you operate a water system . . . or are concerned with the design or construction of water works projects you'll find this digest of facts about Johns-Manville Transite* Pressure Pipe helpful.

A compilation of the advertisements in our current "Engineering Facts" series, it presents concise, factual information about Transite's many economic and engineering advantages . . . includes informative case histories that give a new perspective on how this asbestos-cement pipe meets today's requirements for a modern, efficient water carrier.

In addition, it contains dimensions and other useful data about Transite Pipe which you'll want for your files. A copy is yours for the asking. Write Johns-Manville, Box 290, New York 16, N. Y.

**Transite is a registered Johns-Manville trade mark*

Johns-Manville TRANSITE PRESSURE PIPE

COMING MEETINGS

September **6–7**—New York Section at Otesaga Hotel, Cooperstown, N.Y. Secretary: R. K. Blanchard, Vice-Pres. & Engr., Neptune Meter Co., 50 W. 50th St., New York, N.Y.

8–9—Minnesota Section at Hotel Nicollet, Minneapolis, Minn. Secretary: R. M. Finch, 518 Metropolitan Bldg., Minneapolis 1, Minn.

14–16—Pennsylvania Section at Penn-Harris Hotel, Harrisburg, Pa. Secretary: L. S. Morgan, Dist. Engr., State Dept. of Health, Greensburg, Pa.

22–23—Rocky Mountain Section at Acacia Hotel, Colorado Springs, Colo. Secretary: O. J. Ripple, Ripple & Howe, Cons. Engrs., 426 Cooper Bldg., Denver 2, Colo.

September **22–23**—West Virginia Section at Oglebay Park, Wheeling, W.Va. Secretary: J. B. Harrington, State Dept. of Health, Charleston 5, W.Va. For reservations write: A. R. Todd, Filtration Plant, Wheeling, W.Va.

25–27—Missouri Section at Connor Hotel, Joplin, Mo. Secretary: Warren A. Kramer, Div. of Health, State Office Bldg., Jefferson City, Mo.

28–30—Michigan Section at Park Place Hotel, Traverse City, Mich. Secretary: Raymond J. Faust, Div. of Water Supply, Bureau of Eng., Michigan Dept. of Health, Lansing 4, Mich.

October **6–7**—Iowa Section at Burlington Hotel, Burlington, Iowa. Secretary: H. V. Pedersen, Supt., Water Works, Municipal Bldg., Marshalltown, Iowa.

9–12—Southwest Section at Biltmore Hotel, Oklahoma City, Okla. Secretary: Leslie A. Jackson, Mgr.-Engr. Little Rock Municipal Water Works, Robinson Memorial Auditorium, Little Rock, Ark.

11–13—Wisconsin Section at Hotel Schroeder, Milwaukee, Wis. Secretary: L. A. Smith, Supt., Water Works, City Hall, Madison, Wis.

(Continued on page 76)

Everything factory-made except the ditch

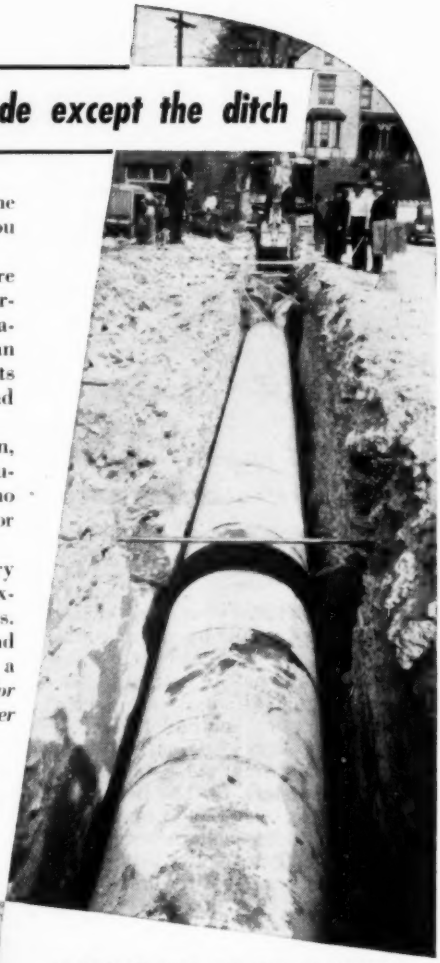
Many a question mark in water line construction is eliminated when you install a coupled steel water line.

Both the pipe and the pipe joint are factory-made under ideal manufacturing conditions. There's no field fabrication, nothing to go wrong. Any workman can make permanent, flexible-tight joints every single time with Dressers, and the only tool needed is a wrench.

You get the full advantage of modern, glass-smooth linings, too. Dresser Couplings fit *outside* the pipe. There's no heat to damage the lining, no need for workmen to go inside the pipe.

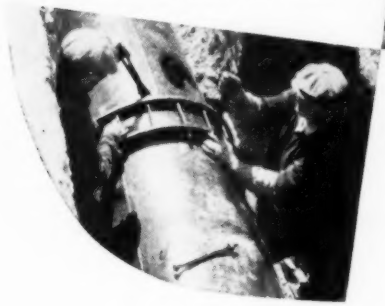
Dressers provide flexibility at every joint—a cushion against vibration, expansion, contraction and other stresses.

For extra safety, easy installation and permanent dependability, specify a Dresser-Coupled steel line. *Write for Dresser's "Report of Coupled Steel Water Lines".*



SIMPLE • FAST • FLEXIBLE • PERMANENT

Even in cramped quarters, Dresser Style 38 Couplings make permanently tight, flexible joints every time.



PARTIAL LIST OF CITIES USING DRESSER-COUPLED STEEL LINES

Cleveland, Ohio	Washington, D. C.
Philadelphia, Pa.	Spokane, Wash.
Detroit, Mich.	Newark, N. J.
Springfield, Mass.	Savannah, Ga.
Boston, Mass.	Denver, Colo.
Syracuse, N. Y.	New York, N. Y.

DRESSER

ONE OF THE DRESSER INDUSTRIES

"FLEXIBLE-TIGHT"

COUPLINGS

Dresser Manufacturing Division, 59 Fisher Ave., Bradford, Pa.—In Texas: 1121 Rothwell St., Houston—In Canada: Dresser Mfg. Co., Ltd., 629 Adelaide St., W., Toronto, Ontario — Sales Offices: New York, Chicago, Houston, San Francisco.

Don't jeopardize your hard earned consumer good-will by letting vile tastes and odors slip into your water supply. Aqua Nuchar Activated Carbon is the quickest, most economical water purification method to control tastes and odors originating from decaying vegetation, algae and industrial trade wastes. It has been used successfully by over 1200 communities to remove odors characterized as vegetable, earthy, woody, bitter, aromatic, fishy, marshy, swampy and chlorine.

Aqua Nuchar is specially manufactured for use in water purification. For nearly twenty years, our Research Staff has carried on tests in our laboratories and in the field to determine the correct combination of activated carbon properties to give optimum taste and odor control. Aqua Nuchar now has these special qualities: superior activation, increased porosity, greater dispersion and better suspendability. Because of its extreme fineness, it disperses more quickly throughout the entire body of water and remains in suspension a longer period of time; the exceptionally porous carbon particles have a greater opportunity to contact taste and odor bodies in the water to remove them by adsorption.

Write to our nearest office and arrange to have our Technical Service Department study your taste and odor problems.

industrial CHEMICAL SALES

division west virginia pulp and paper company

NEW YORK CENTRAL BLDG.	PURE OIL BLDG.	PUBLIC LEDGER BLDG.	LEADER BLDG.
230 PARK AVENUE	35 E. WACKER DRIVE	INDEPENDENCE SQUARE	526 SUPERIOR AVE., N.W.
NEW YORK 17, N. Y.	CHICAGO 1, ILLINOIS	PHILADELPHIA 6, PA.	CLEVELAND 14, OHIO

Journal

AMERICAN WATER WORKS ASSOCIATION

August 1949

Vol. 41 • No. 8

COPYRIGHT, 1949, BY THE AMERICAN WATER WORKS ASSOCIATION, INC.

Contents

Ethics of the Water Industry—*Panel Discussion*
SAMUEL B. MORRIS, WILLARD F. ROCKWELL & MALCOLM PIRNIE 675

Wisconsin Policies on Water Works Funds.....TIMOTHY BROWN 689

Supposed Involvement of Water Supplies in Poliomyelitis Transmission
KENNETH F. MAXCY 696

Planning for Future Development.....MELVIN P. HATCHER 705

Water Supply Problems in the Chicago Metropolitan Area....LORAN D. GAYTON 708

Regulation of Water Use in Air Conditioning.....COMMITTEE REPORT 715

Water Main Extension Policy.....COMMITTEE REPORT 729

Shop and Field Inspection of Steel Water Mains.....EDWARD J. CLARK 742

Discussion.....F. M. RANDLETT 747

Discussion.....RUSSELL C. BEAM 748

Water Department Operation Under City Manager Administration..G. E. ARNOLD 751

Discussion.....REEVES NEWSOM 757

Tentative Standard Specifications for Cold-Water Meters—Current Type—Propeller Driven..... 761

Section Award Policy.....COMMITTEE REPORT 770

Departments

Cover Story .....*text p.* 707
Officers & Directors ii
Division & Section Officers iv
List of Advertisers vi
Coming Meetings .....viii, 76
Percolation & Runoff 1
Membership Changes 28
Correspondence 36
Condensation 44
Service Lines 66
Section Meeting Reports 70
Index of Advertisers' Products 78

Reproduction of the contents, either as a whole or in part, is forbidden, unless specific permission has been obtained from the Editor of this JOURNAL. The Association is not responsible, as a body, for the facts and opinions advanced in any of the papers or discussions published in its proceedings.

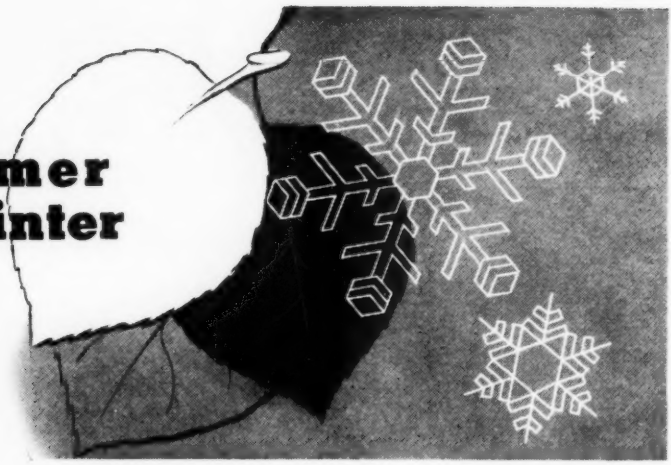
Indexed annually in December and regularly by *Industrial Arts Index* and *Engineering Index*.

All correspondence relating to the publication of papers should be addressed to:

Harry E. Jordan, Secretary—500 Fifth Avenue, New York 18, N.Y.

ERIC F. JOHNSON, *Editor*
DANIEL N. FISCHEL, *Managing Editor*
LAWRENCE FARBER, *Associate Editor*
ELIZABETH P. MCSHERRY, *Associate Editor*

$7.00 of members' dues are applied as a subscription to the JOURNAL; additional single copies to members—50 cents; single copies to non-members—75 cents.



BREAK-POINT HELPS THIS WEST COAST WATER WORKS

Typical of what Break-Point Chlorination can accomplish is this case history.

A 1½ mgd. west coast water works using an impounded supply was troubled by summertime odors so acute that settling basins had to be washed almost continuously, while in the winter, color ran as high as 600 ppm. To overcome these troubles, several treatment methods were tried—unsuccessfully. Then W&T Engineers, in cooperation with the plant staff, carefully analyzed the situation. At their suggestion, the Break-Point Process was employed, using W&T Chlorinators for pre-chlorination. With this treatment, according to a report by staff members, color troubles, together with complaints concerning iron and manganese stains, were eliminated; filter runs increased; and summertime odors cut almost to the vanishing point.

In addition to such direct chlorination benefits, when you call on W&T you have the added assurance of W&T's 35 years of chlorination experience—a full line of chlorinators from which to choose—the backing of extensive research and development facilities—and finally, a top-notch, alert field organization at your call for prompt service and technical assistance.

For more details, ask your nearest W&T Representative —he'll be glad to help you.

The W&T Residual Chlorine Recorder is especially valuable in securing the best possible results with the Break-Point Process.

WALLACE & TIERNAN
COMPANY, INC.
CHLORINE AND CHEMICAL CONTROL EQUIPMENT
S-39 NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

Journal
AMERICAN WATER WORKS ASSOCIATION
VOL. 41 • AUGUST 1949 • NO. 8

Ethics of the Water Industry

Panel Discussion—Samuel B. Morris, Willard F. Rockwell and Malcolm Pirnie

Presented on June 1, 1949, at the Annual Conference, Chicago.

Samuel B. Morris

Gen. Mgr. & Chief Engr., Dept. of Water & Power, Los Angeles.

EVERY professional society has a code of ethics or practice, either formally adopted or implied. The first canon of the A.W.W.A. Code of Practice reads:

"1. To the best of my ability I shall conduct all operations under my control in such manner as will, *as far as the means made available permit*, provide adequate water services, preserve the public health and furnish protection to property."

Standing alone, this expression of public responsibility appears an understatement for those charged with the full burden and opportunity of planning and directing the construction, operation and maintenance of water works to provide adequate service to their communities. Certainly it is the duty of all water works executives to study and plan needed improvements, and to marshal facts before boards, stockholders, citizens and the electorate sufficiently in advance of need, so that there may be no occasion to point to any failure to foresee a controllable condition or event which has brought about an interruption of service or outbreak of disease.

Stimulating Public Interest

Perhaps there is no field of service to man which is more fundamentally necessary, and requires more thorough and complete 24-hour-a-day, year-in-and-year-out attention to duty, than supplying water to every household—wholesome, palatable water for drinking, culinary, bathing and sanitary purposes—and at the same time maintaining adequate volume and pressure for horticulture, industry and fire suppression. And yet, especially in the larger cities, the people served have little or no interest in information on the ade-

quacy of sources of supply and works so long as water flows when they turn on their faucets.

In the cities of the Far West, and in other regions of rapid growth, there is an added factor in consumer lack of interest: the recent arrival in the community of thousands of new citizens, who, irrespective of whether they are the owner-consumers of the public system or are served by a privately owned corporation, accept water service as a matter of course. Water works management must be alert to the obligations imposed by this blind faith. The public should be adequately informed of the true situation and its support enlisted whenever group action is required to authorize bond issues for needed improvements, or to change rates or rules.

Twenty to twenty-five years ago citizens of Los Angeles and neighboring communities organized the Boulder Dam Assn. and the Colorado River Aqueduct Assn. to aid in obtaining legislation and a $220,000,000 bond issue to bring Colorado River water to Southern California. The aqueduct has been completed eight years, and the population has more than doubled since the works were authorized. There has been continuous controversy between California and Arizona over their respective rights to Colorado River water, and yet the citizens of the 28 communities now constituting the Metropolitan Water Dist. of Southern California lost interest in their lifestream. To support needed federal legislation and oppose adverse bills, it became necessary for the responsible management to reawaken the citizens of Los Angeles, the Metropolitan Water Dist. and the state of California to the peril to their water supply. This is an example of the water works executive's responsibility to the citizens of his community. He must be ever on the alert to see that consumers have adequate knowledge to act intelligently to protect and develop their water works in their own interest.

There are many opportunities for mutual cooperation with agencies of public health and public works, regulatory commissions and fire and police departments. In addition to his own community, the water works executive has many contacts with government officials at all levels—city, county, state and national. He should be recognized as a professional business executive in his field and should conduct himself accordingly. Water works management should stay aloof from party and personal politics but cannot withdraw from necessary activity in legislative halls, local and national. There are dangers of legislation unfavorable to the utility, as well as constructive legislation needing support in the public interest.

But, quite naturally, the most immediate responsibility of the executive is to maintain cordial dealings with, and the respect of and for, everyone in his own organization, both those to whom he is responsible and those responsible to him. Only then may the activities of the utility be well and faithfully performed.

Labor Relations

This observation brings into the foreground relations with employee representatives. There was a time when labor organization was foreign to the water works field, as it still is in many smaller communities. Beginning with crafts, unionization has progressed to engineers, draftsmen, clerks and super-

visors. To add to the problems of fair dealing and proper salaries and wages, sickness and death benefits and retirement plans, there are jurisdictional disputes between labor groups. These become especially troublesome in connection with work on consumer premises or work performed by contractors and subcontractors. At all times decisions should rest on what best aids the utility in its service to the public and gives a fair deal to all concerned.

There is an inherent conflict between civil service—which seeks to obtain the best qualified employees irrespective of membership in any faith, creed, political party or organization and to protect the employee in the security of his employment—and some elements in union labor, which seek to restrict union membership or to require maintenance of such membership. There is the further liability of jurisdictional disputes, strikes and work stoppages which disregard the public interest.

The distinctions between government and private enterprise were pointed out by such a friend of labor as the late President Franklin D. Roosevelt, in a letter to the head of a union of federal employees, which stated, in part:

> All government employees should realize that the process of collective bargaining, as usually understood, cannot be transplanted into the public service. It has its distinct and insurmountable limitations when applied to public personnel management. The very nature and purposes of government make it impossible for administrative officials to represent fully or to bind the employer in mutual discussions with government employee organizations. The employer is the whole people, who speak by means of laws enacted by their representatives in Congress. Accordingly, administrative officials and employees alike are governed and guided, and in many instances restricted, by laws which established policies, procedures or rules in personnel matters.

One continuing problem is that of "outside work" engaged in by employees of the water system. The test is whether the work is compatible with the employees' regular duties, with regard to both the added hours of labor and the relation of the outside employer to the water works. The energies and capacities of individuals vary so greatly that it is possible to lay down only general rules. Each case must be decided fairly on its merits. Of course, it is much simpler and more satisfactory to management if all employees devote their total working time exclusively to their job with the water works. And there is one point on which all must agree: no employee should accept or be permitted to accept work or compensation from any supplier or contractor with whom the water utility is having or may have business dealings.

Rates and Regulations

Regulations covering the sale of water, rates and rules of service of each water works are generally fixed by state regulatory bodies, city ordinances or resolutions adopted by the water works. They are or should be carefully drawn to distribute equitably the cost of service between classes of rate payers, so that each class pays its fair share, without assuming increased burdens for some class of customers who may not be contributing the full cost of their water service. There should be no water or standby service below cost. It is therefore necessary that each water works know its cost of service and properly incorporate it into the requisite rate schedules.

Purchasing Materials

In purchasing materials, supplies and equipment the water works executive seeks to buy as economically as possible. Specifications should be broad to invite fair competition and obtain the lowest prices. Public agencies, in general, must advertise for bids and award to the lowest responsible bidder. Frequently trade associations tend to control prices, and all bids will be found to be equal in spite of the usual affidavits of noncollusion. When shipments are from widely spaced locations throughout the United States, and different amounts of freight costs are involved, it tests one's credulity when all f.o.b. manufacturers' plant prices vary so that the unequal freight allowance will result in f.o.b. water works plant costs exactly equal, to the penny.

Not infrequently an unsuccessful manufacturer or his salesman will express dissatisfaction at not being given the award after submitting an identical bid, and will claim favoritism toward his competitor. It should be apparent that when there is no price competition, the water works management is free to choose at will by flipping a coin, favoring the concern that has given the best service, making a reasonable distribution of business or, as has sometimes been done, making all awards to one manufacturer in an effort to break up the practice of identical bids. In any event the unsuccessful bidders have no cause for complaint, for any one of them could secure the business by a lower bid.

The A.W.W.A., the American Society for Testing Materials, the American Standards Assn., various national engineering societies, the Bureau of Standards and the U. S. Dept. of Commerce have done much to provide uniform specifications for material and equipment and tests which secure higher standards and lower costs and promote fair competition. The use of these standards is helpful both to the utility and to the suppliers and contractors.

Water works performing force account work are frequently under great pressure to abandon this practice in favor of contract work. There can be no fixed rule in this regard. Efficient management requires that the best economy shall be observed and that sufficient trained personnel shall be maintained by the water works to protect the continuity of service under all conditions of catastrophe or conflagration. In general, the water works should be able to function most economically in its fields of normal activity when adequate and efficient equipment and trained crews can be steadily employed. For large and unusual projects, contract work may be found more expeditious and economical.

Employing Consultants

The ideal method of selecting consulting engineers, architects, geologists, certified public accountants, special counsel and other professional services is by an examination of the records of training and experience, in order to obtain the best personnel and services available, with due consideration to possible conflicts in employment, and with proper economy. Never should professional services be selected on the basis of competitive charges, fees or per diem compensation. Unfortunately, there are some public agencies which, under rulings by their attorneys, are given no other alternative than to advertise for bids for professional services in the

same manner as for the purchase of goods and supplies.

The terms of employment of consultants, and the person or persons to whom they report, should be definitely fixed and understood. The author can recall several severe conflicts between professionals. In extreme instances charges have been filed under technical society codes, and some men have been dropped from membership because of such conflicts. Other cases have come before state licensing bodies. All such controversies can be avoided through carefully drawn contracts of employment and the exercise of the normal personal courtesy which one professional owes another engaged by the same employer or in the same work.

Sometimes conflicts among professional men arise from proposed public works when bond elections, property condemnations, appraisals and other issues are presented to the public by means of the press, the platform and the radio. There should be ample opportunity to present opposing views without engaging in personalities or derogatory remarks. The author confesses to some little dismay at an attitude expressed by some prominent engineers, to the effect that it is not unethical to make unfounded, untrue or false statements regarding an engineer in public employment.

Release of Information

One of the problems always requiring great care is that of keeping certain information confidential, and at the same time not being unduly restrictive when there is necessity for discussion and action. Frequently there is no official statement that the matter in question is confidential and only one's experience and habit of conduct are his guide. On the other hand, the whole gamut of the United States classification—classified, restricted, confidential, secret and top secret—may be involved, requiring various types of military or civilian clearance.

For example, visitors from foreign countries arrive who desire to learn as much as possible about American water works and methods. The State Dept., the military services and other agencies will often send foreigners from unfriendly or questionable nations to inspect plants, but when asked what clearance the visitors have, the government officials merely say, "Whatever you show them is your own responsibility." In such an event, a rather general field inspection is in order in which the visitor sees no more than is generally available without special guide service. A thorough opportunity should also be provided for discussing methods, standards and more general technical, business and economic matters. Such discussions should encourage a friendly, professional exchange of ideas and information without jeopardizing security.

Executive Responsibilities

To the author, one of the principal sources of satisfaction in public utility operation and management is the breadth and completeness of the service rendered. The head of such an organization not only designs and constructs important engineering works but also operates them. He has the opportunity to learn at first hand what changes in design will produce better and more economical operation. He can watch the behavior of materials, automatic devices, manual controls, biological life in lakes, streams and reservoirs; and he can develop the best means of pro-

viding a high quality of water, free from tastes, odors or disease. Then, too, he is responsible for financial matters, for the creation of satisfactory public opinion, and for the maintenance of good management-employee relations.

It must be perfectly obvious that the chief engineer or general manager cannot be fully and equally expert in all of these fields. He should recognize the need for highly trained personnel and advice based upon broad experience in the many fields that are involved in operating a modern water works. He must divide responsibility and authority to obtain maximum coordination and efficiency with a minimum of friction. His organization should be encouraged to be active in professional societies, to contribute papers describing advances and new developments, and to join in the discussion of papers prepared by others.

The water works executive should encourage and make possible the participation of members of his staff in water works conferences, such as those sponsored by the A.W.W.A., locally and nationally, by the American Public Health Assn. and by the national engineering societies. These conferences provide water works men with an opportunity to increase their acquaintance with those performing similar work in other parts of the country, to exchange ideas and information and to gain new inspiration. Occasionally those responsible for operating methods should have the opportunity of visiting and studying other water works, with all plants providing access for this type of visitor.

The employment of consultants not only secures expert services in specific fields, but should bring to one's own organization the benefit of intimate knowledge and experience gained from the solution of similar problems in other localities. There should be a free flow of information between the staff of the water works and the consultant in order that the latter's broad experience may be further directed to the specific and perhaps unusual conditions which may obtain at the local water works. The water works operator has had the best chance to observe local conditions and the behavior of structures and equipment, and this knowledge is essential to the consultant in order to serve his clients best.

The many manufacturers producing water works materials and equipment are always striving to improve their products. The water works man should study the operation of his equipment and, by the interchange of information and ideas with the manufacturer, should aid in the continued improvement of material and equipment, especially where local conditions may require some deviation in design or operation. The A.W.W.A. and the Water and Sewage Works Manufacturers Assn. have greatly assisted in this work by fostering friendly relations among manufacturers, suppliers and water works men.

Generally speaking, publicly owned water systems operate as monopolies in an unregulated field. No state utility commission examines their efficiency and operating effectiveness. The stockholders are the public, and the boards of directors are elected or appointed city officials who serve as lay councilmen or commissioners. The publicly owned water works generally pays no taxes within the city but may make substantial payments to the general city funds, either in free service or service below cost, or by the transfer of funds.

Some water systems receive tax support either directly or in bond interest and redemption service, or they may get contributions toward the construction of mains and services. Such wide variations in financial policy make it incumbent upon water works management to keep careful accounts of operation costs and present them in such a manner that there is a means of comparing the costs of service in one locality with those of other communities. The effective interchange, between water works, of cost information that is truly comparable should be the best way of checking efficiency of operation. As regulation is not forced upon publicly owned utilities, they should take the initiative in developing and analyzing these comparisons, to make certain that they do not become soft and inefficient in rendering service to the citizen-consumer-stockholder. With so much regulation in this country, municipally owned water works are fortunate in remaining free to develop and set their policies on a local level the better to serve the desires and needs of the citizens. This condition adds to the opportunity and responsibility of municipal water works management.

The municipally owned water works seldom advertises its services and even more rarely engages in institutional advertising a fault that undoubtedly should be corrected. Although the service of water is monopolistic in character, there is information which the public should have, such as that on adequate piping and fixtures, avoidance and elimination of cross connections, protection of water supply and avoidance of pollution, details regarding the availability and permanence of water supply, and major plans, plants and expenditures. Institutional advertising must avoid statements aimed at directly influencing the voter in political affairs.

Looking back over 38 years of activity in the water works field, from engineer of a small private water company serving less than 10,000 persons to the service of water and power to a city of more than 2,000,000 population, the author can say with firm conviction that there is in this field a challenge and satisfaction in service to one's community, a professional esprit de corps and a fraternity and general neighborliness among water works men which are so overwhelming that it gives life and strength to ethics in its true sense of good will among men.

Willard F. Rockwell

Pres., Water and Sewage Works Mfrers. Assn., and Chairman of Board, Rockwell Mfg. Co., Pittsburgh, Pa.

To discuss the question of ethics requires a definition of terms. The dictionary indicates that "ethics" and "morals" are synonymous and, therefore, what is unethical is immoral. Since it is also stated that conforming to professional standards of conduct is ethical, all that is needed is a code of standards. It is generally recognized that everything which is illegal is not necessarily immoral. In this discussion, it will be assumed that whatever is illegal can be omitted, unless it is believed that the present illegal status detrimentally affects ethical conduct and practice.

This discussion is intended to cover the relations between water works operators or management and the manufacturers, contractors and purveyors of water works equipment, supplies and services. It also includes relations be-

tween these two parties and consulting engineers who are employed or authorized to determine the specifications, and sometimes to conduct the actual purchase negotiations, for construction, equipment, supplies and services to be used in the design, construction and operation of water works—extending from the selection of the sources of water supply, pumping equipment, chemical and bacteriological treatment and distribution to the final disposal of waste products through sewage systems.

The first consideration of all three parties should be the ultimate consumer, who usually supplies the capital and operating funds through bonds, taxes and direct payment for water he uses. For taxpayers, customers, manufacturers and citizens, here is a definition of ethical requirements: Any act, or failure to act, which gives the customer just cause for complaints of waste of his money, inefficient service or lack of proper quantity and quality of water is unethical. If the customer as a taxpayer refuses to vote or provide the funds needed for good service in such a vital necessity as water, he has only himself to blame. Furthermore, as the taxpayer is both customer and owner, he is responsible for the kind of management which is currently in charge of water service and water supply investment.

As President of the Water and Sewage Works Manufacturers Assn., the author was asked to present the manufacturers' viewpoints and suggestions on higher ethics in the competitive field and in their relations with water works operators and consulting engineers. In an attempt to compile and condense the views of this group, the association has consulted its members, and the author will try to summarize their constructive criticisms.

Remembering the biblical injunction not to point out the mote in our brother's eye until we have considered the beam in our own, the author will try to present opinions on the ethics of competition between competitive manufacturers and purveyors of materials, supplies and services. If more than lip service is to be given to ethics, each group must first raise its own standards so that its house is in order, and thereafter it must display the eternal vigilance necessary to keep it that way. It is now generally considered that business is in a recession which may grow into a depression; and this condition brings to mind the fellow in the fiercely competitive, cheap clothing business who said to his partner, "Business is getting better, so we better talk ethics to our competitors." There are few competitive situations where the rise in business volume is not accompanied by improved ethics; and, conversely, keener competition results in lower ethical standards, even when it does not cause reversion to the law of the jungle.

Sales Practices

Every selling organization has to train young salesmen. Before they are trained, they frequently resort to unethical practices on their own initiative, because they have not learned that such practices are detrimental to the trade and eventually are extremely costly to all concerned. The salesman who invents a sharp trick to make a sale cannot patent his method, and, therefore, as soon as his trick is exposed, it is available to any other competitor. Competitors then have an alibi that they have adopted the new trick or resumed the unethical practice in self-defense.

There was a time when most salesmen carried one beautifully polished sample model of their own product to show to every prospective buyer, and also a sack full of rejected or broken parts from competitive products, which they would show to prospective buyers to convince them that the competitive products were a poor purchase at any price. There was a time when a salesman tried to discover the buyer's political, religious, racial and social prejudices, after which he attempted to convince the buyer that he and his company were on the same side of the fence, while all his competitors were on the opposite side; and sometimes he was caught on both sides of the fence. In established business lines, all these practices were once tried out and eventually given up as wasteful, when it was recognized that each trick aroused competitive resentment far beyond that caused by merely losing an order. The most vicious and unethical business conduct is always found when the personal pride and prejudice of business rivals is aroused by unethical sales methods, because it is quite human to be willing to forego a profit in order to satisfy a desire for revenge. The intelligent, ethical buyer is the prime force in discouraging unethical selling practices. The buyer is sure to be resentful if he knows his own company's sales force is faced by such sordid practices.

The worst example of unethical practices among manufacturers in this field which was brought to the author's attention is one involving a young salesman. Though paid for full-time service by one manufacturer, the salesman was able to make a deal with a competing firm under which orders he had obtained in the name of his first employer were accumulated and withheld until he resigned and were thereupon turned over to his new employer. The latter then made every effort to ship his product as a substitute. In discussing business ethics with many young salesmen and relatively inexperienced businessmen, it is found that some are completely convinced that their particular product is so superior to all competitive products that any consulting engineer or water works operator who does not specify and buy their product must be acting under some sinister influence. The simple statement of such a situation supplies its own answer. Most consulting engineers and operators are eager to secure products or services which they believe will produce the most satisfactory results for clients and customers.

On the other hand, the engineer or operator who conscientiously and completely examines, experiments, inspects and inquires to determine the best available product or service is not doing his duty if he thereafter refuses to look over any new or recently improved products. Such an attitude discourages the initiative, ingenuity, ambition and hopes which have made this country the most successful in the world's history.

It should not be surprising, therefore, if a manufacturer regards with suspicion any prospective buyer who refuses to compare a new product, or any available product, with the one which gets his first consideration. Furthermore, if a consulting engineer has been employed by a manufacturer in the design or testing of a product offered to the water works trade, a competing manufacturer may fear some prejudice if the same consulting en-

gineer is assigned to design, construct or make purchases for a water plant or any part thereof which requires his former employer's product.

Unreasonable Requirements

A few manufacturers understandably complain that some consulting engineers and operators specify an inadvisable or unreasonable standard of efficiency or accuracy which is not justified when the slight increase in accuracy and efficiency is gained at the expense of complicated design and lessened reliability. As an illustration, it is possible to increase the efficiency of a steam turbine by cutting down blade clearances until the danger of breakdowns and interruptions in service completely offsets any saving of fuel. It is far worse, however, to specify a theoretical efficiency which cannot be obtained in practice and then award the contract to an unethical bidder who guarantees such an improbable efficiency, knowing all the time that no real test is to be conducted after installation. This practice automatically eliminates the honest manufacturer who is unwilling to guarantee performance which he knows neither he nor his competitor can meet.

Consulting engineers occasionally complain that some manufacturers (usually the larger ones) offer the equivalent of free consulting engineering services. It is a moot question how far the manfacturer should go in offering any so-called "free services," because every intelligent buyer knows that they are actually included somewhere in the price paid by the customer. The buyer must also know that the manufacturer will surely be somewhat prejudiced about the value of his own products and, therefore, his recommendations cannot be rated so reliable as those of an independent and conscientious consulting engineer or operator.

Detrimental Municipal Practices

All of the trade and professional practices of operators, engineers and manufacturers come under the heading of ethics, but some doubtful trade practices are imposed on the three groups by other interested parties in many municipalities. Legislative bodies enact laws or ordinances and goverment executives adopt rules which regulate and control the method of purchasing goods and services required by the water utility. In many communities where graft and corruption have been exposed, or where the authorities intend to build up a defense against such possibilities, the law states that all purchase requirements must be advertised and the order must be given to the lowest bidder who meets the specifications.

If the consulting engineers and operators are honest, such a law can be a serious handicap to intelligent buying. On the other hand, if there is dishonest management, the law itself provides a means by which tricky specifications can be used to bar all but one manufacturer who, by collusion and conspiracy, can then obtain a contract for goods or services above the prices submitted by his competitors, and sometimes at far higher prices than those submitted concurrently to honest buyers in other communities.

Manufacturers report that credit experience with municipalities varies vastly. The credit rating is relatively easy to establish and credit losses, therefore, are comparatively small, but conformance to specified payment terms is notoriously neglected in a few cities. Manufacturers report that if they offer

10 per cent–10 days, or as high as 5 per cent–30 days, they have to wait many months for their money, and then the official who sends the check deducts the discount. It would obviously be unfair to every conscientiously complying customer to allow such deductions to any who do not earn them. As a result of such experiences, many manufacturers have adjusted prices and terms to eliminate cash payment discounts. But some municipalities have set up the rule that every bidder must allow a cash discount. They have been known to accept a bid without a specified or agreed-upon cash discount and then deduct one regardless of terms.

Trade Restrictions

Some manufacturers sell through their own full-time sales personnel, while others believe it better business to sell through agents and distributors. Some municipalities, probably prompted by an overzealous local trade organization, specify that any and all bids must be placed through a local agent or taxpayer. Such a practice is often unfair and sometimes proves to be wantonly wasteful.

One of the great men for whom the author was privileged to work many years ago laid down an ethical principle of buying so emphatically that it can never be forgotten: "Never disclose a quotation from one competitor to another before placing your order." This principle is now more honored in the breach than in the observance.

Under American practice, when a customer goes into a reputable department store, he finds a price tag on every article offered for sale and wastes no time trying to bargain for a better price. But in most foreign countries, the first price is only the asking price. If the customer does not proceed to bargain, he will pay much more than necessary. Unless he is a skilled, experienced buyer, he will never know the fair price he should have paid. Everyone must see that the American way is fairer, saving time and money for both parties. Under the maze of conflicting legislation which attempts to control interstate business, a manufacturer who sells his goods to competitive customers at the same delivered price in every state of the Union is breaking the law; while a manufacturer who has a different delivered price in every state can be held guilty of discrimination, unless he can prove that each price is justified by actual costs. Because water works are not considered in competition with each other, this legal entanglement is avoided.

Buyers' Ethics

Economic experts say business is in a recession, which may develop into a depression. Now is the time for government agencies to build and expand all public service facilities where warranted by present or near-future demands. However, if buyers use this obvious opportunity to beat prices down by any unethical means, strong producers will survive, but weaker ones may fall so fast as to invite further disaster; and so recovery may be retarded and monopolies encouraged.

Having been held personally responsible for corporation product sales exceeding a billion dollars in the last decade, and also responsible as a director of procurement in a government agency for purchases of over a billion dollars in products and services, it is the author's opinion that the buyer is more responsible than the seller for establishing a high standard of ethics. The ethical buyer can insist on ethical selling practices and reject both the

improper selling tactics and the bids submitted by doubtful purveyors, while the seller cannot always control or know of the bad practices of his representatives, who may operate at distant points. The seller may also be coerced either by the buyer or by necessity into meeting unethical practices in order not to abandon his hope of expanding or even surviving. If buyers insist on ethical selling, the seller must conform or lose out.

As a manufacturer of water meters, the author might be expected to say that it is unethical to charge the customers of any water utility on any basis except actual measurement. Consequently, it will not be necessary to enlarge on that theme. So many good operators and consulting engineers agree on this proposition that meter manufacturers consider it an accepted principle—except in a few small communities such as London, New York, Philadelphia and Chicago!

In closing, it may be helpful to recall that a great, but little known, jurist recently said: "It is a greater honor to be trusted than to be loved." Everyone knows some good mother whose deepest love is lavished on a wayward child who cannot be trusted out of her sight. If men in the industry, whether operators, engineers, manufacturers, contractors or purveyors, could confine their transactions to people or corporations they knew they could trust, the question of ethics would be settled forever.

Malcolm Pirnie

Partner, Malcolm Pirnie Engrs., New York.

The free discussion of basic ethical problems in industry admits that there are imperfections in the continuing evolution of the principle of free enterprise. With all its imperfections, however, there is ample proof of benefits towering above any previous pattern of society the world has known. Throughout history men have fought and died for the vision of its attainment. The established momentum of its evolution must be defended to ultimate victory.

Among the beneficial services that have earned professional stature for the engineer, none is more essential than that of providing an adequate volume of wholesome, potable water, delivered to the public free of harmful contamination. No greater public trust of the engineering profession and the water works industry could be evidenced than the almost universally unquestioned use of drinking water from the faucets in the American communities visited by the mobile citizens of the United States. Such confidence emphasizes the corresponding responsibilities of engineers, operators, builders, manufacturers of equipment and supplies, and all others constituting the personnel of the water works industry.

Next to fresh air, healthful, potable water is the cheapest commodity, measured by volume or weight, essential to life. Its worth delivered into the home under pressure is such that at least four volumes are consumed from the distribution system for uses other than drinking, cooking and washing. Uninterrupted service and capacity to deliver such volumes have added fire protection service to the life-promoting responsibilities of all moderate-size and larger water works.

Adequate Return Essential

Such an indispensable industry has earned and should enjoy the whole-

hearted respect and willing support of the users of its product and services. To be competently staffed, dependable and capable of expansion to serve a growing community, it must be run at an adequate profit. Public management or rate-regulating authorities must recognize this primary need for a thriving water works industry or shoulder full responsibility for any resulting impairment of the public health and the protection of the people's homes and business establishments against fire.

No two communities are identical, and neither are the water works required to serve them. It would therefore be only by chance if the rates for adequate water and fire protection services should be the same in both. It is a painstaking engineering and accounting task to divide the costs of water works services equitably among all users, from the smallest to the largest consumer of water. When average rates are charged for each of the various classes of services which closely approximate their costs, none of them is burdensome. For example, an equitable rate for adequate fire protection is offset in large measure by substantial reductions in fire insurance cost, and any consumer of water can adjust his use to the volume for which he is willing to pay.

A skillfully engineered water works, competently managed and staffed, will be maintained in first-class condition, and be reinforced and extended to provide anticipated expansion of services, if the established rates for such services produce revenue sufficient to pay the costs of operation and maintenance while providing an adequate allowance for depreciation and a reasonable return on the fair value of the entire water works property. This latter requirement is of primary importance. If lacking to any extent, it will be sought by reductions in maintenance, decreased competence of staff, management or engineering personnel and deferment of reinforcements and expansions, until inadequate water works services retard the prosperity and threaten the health of the community.

Water works, large and small, are units of big, vital business, each benefiting by the experiences and improvements of the others. Their coordinating agency in the Americas is the A.W.W.A. This volunteer grouping of leaders in the industry is discharging its public trust. Many members make generous gifts of time and money to advance the art, broadcast the lessons learned from experience, and raise the standards of materials, equipment and services competitively available to all who want them. The water works industry is a creditable part of the American economic system. Based upon the Golden Rule, the ethics of each industry should be the same as for the entire economic system.

Moral Obligation

In 1948 Clarence Francis, Chairman of the Board, General Foods, Inc., and member of the Research and Policy Committee of the Committee for Economic Development, phrased a most enlightened analysis of the "Responsibilities of Business Leadership to the Public." With his permission, several quotations from his inspired address are presented, including what is believed to be the first completely positive pronouncement of faith and will to discharge the moral obligations of freedom:

Today, most managements, in fact, operate as trustees in recognition of the claims of employees, investors, consumers, and government. The task is to keep these forces in balance and to see that each gets a fair share of industry's rewards.

. . . Perhaps a sort of Hippocratic oath could be devised to remind us of the moral responsibilities of true business leadership. . . . It might run like this:

I believe that a business must be run at an adequate profit and must hold its own in fair competition with other businesses. *Within my sphere I will do my level best to help keep my business prosperous and strong.*

I believe that business must serve employees, stockholders, consumers, and government and that management must keep the interests of all these elements in balance. *To the extent of my authority I will try to preserve this balance.*

I believe that management's operating goals are continuously improved productivity and growth, in order to provide jobs, reward investors, attract capital and provide more and better goods and services at lower cost. *In any capacity in which I find myself I will work toward those goals.*

I believe further that a business' greatest assets are its human assets and that the improvement of their value is both a matter of material advantage and moral obligation; I believe, therefore, that employees must be treated as honorable individuals, justly rewarded, encouraged in their progress, fully informed, and properly assigned, and that their lives and work must be given meaning and dignity, on and off the job. *If I have the supervision of so much as one other person, I will strive to honor these principles in practice.*

I believe that a reputation for integrity is another priceless asset of any business and that management must deal fairly with customers, competitors, and vendors, advertise truthfully, fulfill its commitments, cooperate with other managements in the betterment of business as a whole, and oppose any artificial restriction that may limit production, fix prices or restrain trade. *In my daily work I will try to deserve, and make my business deserve, a reputation for integrity.*

I believe that the future of the American economic system depends on the confidence, good will, and understanding of the people and that business leadership must make itself a responsible part of the human community by participating in worthy activities locally and nationally. *As a representative of business and as an individual I will identify my business and myself with the welfare of* people.

I believe that whenever business has earned a hearing, it has not only a right but a *duty* to ask for public confidence and that it must speak freely, give information gladly, and answer the attacks of those who seek to undermine American freedom under democratic capitalism. *I will speak out in behalf of my business and the system which it represents.*

I believe finally that business leadership is nothing less than a public trust, that it must offer a message of courage and hope to all people, and that it can help an economically strong America to lead other nations to lasting prosperity, freedom, and peace. *I will work not only for the advancement of myself, my family, and my country but for liberty and democracy for America and for the world—now and in the years to come. . . .*

Let us reject cynicism in all its forms and accept the challenge of tomorrow. Within and beyond our borders, it is in the realm of moral principle that the real responsibility of businessmen will be discharged. The test of leadership is its capacity to *lead*. We have the principles and we know them to be sound. We need the faith and the will to make them work.

Wisconsin Policies on Water Works Funds

By Timothy Brown

A paper presented on June 1, 1949, at the Annual Conference, Chicago, by Timothy Brown, Commissioner, State Public Service Commission, Madison, Wis.

WISCONSIN is one of the few states in which all water utilities, even though owned by municipalities, are regulated by a state commission. This body, called the "Public Service Commission," is the creation of the state legislature, which has given it jurisdiction over all public utilities, whatever their ownership. In administering this regulation, the Public Service Commission is performing a legislative function, as the legislature has laid down the fundamental principles and standards but has delegated to the commission the detailed work of making the principles effective.

Wisconsin law does not consider that, in owning and operating a water works, a city is performing a governmental function but rather that the municipality is conducting a public service in its proprietary capacity. The statutes expressly authorize any municipality to own and operate any public utility—subject to the regulatory powers of the state as represented by the Public Service Commission (Chapters 196 and 197). The regulation of operation is fairly obvious, but it may be a little surprising that the method of financing the acquisition or construction of a water works by a municipality is also made subject to the approval of the commission (Section 66.066). Once acquired, the municipally owned plant has to furnish reasonably adequate service and facilities at reasonable rates precisely as does a privately owned utility. The better to insure such service, the legislature has attempted to remove the water system from the field of politics by directing that cities must, and towns and villages may, manage their water systems by a board of three, five or seven persons under the general supervision of a city council or village board. Very small cities are given the right to manage their utilities by a board of public works, composed of the city attorney, comptroller and engineer.

Nonpartisan Management

The Public Service Commission considers that the keystone of sound and effective regulation is nonpartisan management and that, to a large extent, it is indispensable for satisfactory service to the consumers. In Wisconsin's experience, politically administered water systems have so frequently been in financial and operational difficulties that the commission meets with considerable success in its recommendations designed to establish truly nonpartisan and businesslike management. It is hardly necessary to point out the desirability, from the standpoint of the consumer, of removing the election returns from the list of problems the utility management must face; but it may not be superflu-

ous to examine briefly some of the differences between the management of a municipality and a business enterprise.

Government fiscal policies are predicated on deficit financing. Obligations are first incurred or determined and then taxes are levied or funds borrowed to meet requirements. Such a policy is inimical to the conduct of a business which, in the long run, must live within its income or fail. The expenditures of a water utility must be carefully budgeted to conform to the income pattern. Likewise, income itself lacks the flexibility ordinarily associated with the taxing power. Of necessity, most municipal functions are conducted on a short-term basis. Needs are constantly changing, and the municipality usually is in a position to exercise considerable discretion in making financial commitments and construction outlays. Thus, street and park improvements may be accelerated or delayed as the electorate may decide. In contrast, the water utility owes a duty of service to its patrons which is immediate and to a considerable extent uncontrollable. The water utility plant must be designed and planned on a long-term basis, so as to be ready at all times to meet the needs of its patrons.

The conflict in ideology underlying the operation of a water utility and the fulfillment of other municipal functions is further demonstrated in the personnel qualifications involved. Although business acumen is a highly desirable qualification for councilmen, it is not always obtained and, in any event, must come second to the ability to be elected. However, it is indispensable to efficient municipal water utility operation. The ordinary councilman is usually responsive to various short-term, partisan local and provincial political considerations, some of which may be and frequently are detrimental to the long-term interests of the municipal water utility.

The practice is subject to censure, but it is nevertheless true that councilmen are prone to seek favors for their constituency or the particular segment of it to which they feel obligated. The antidiscrimination laws and the common-law duty of service imposed upon utilities do not leave room for the granting of favors in the extension of service or in rates, but when the utility is operated directly by a political body, such principles tend to be overlooked. In most states, the municipalities have considerable leeway in accounting, budgetary and fiscal practices. Subject to certain restrictions, they are a law unto themselves. On the other hand, utilities under state regulation are enjoined to follow specific accounting and fiscal practices and are required to keep records in a manner and in detail not customarily required of municipalities. In still many other ways, the functional cleavage between utility operation and the management of civic affairs can be shown to differ so widely as practically to dictate a separation of utility management from other municipal operations. When such a separation does not exist, the utility is usually considered as just another department of the municipality instead of being regarded as the business enterprise it is.

In order that the management may be nonpartisan in fact as well as in name, the Wisconsin Public Service Commission has recommended to municipal officials that:

1. Individuals who have votes on the governing board of the municipality should not serve on a utility board or commission.

2. The utility manager should be hired by the utility commission; should be responsible to the commission; should have tenure; and should be given broad latitude in the supervision of the day-to-day operations of the utility.

3. The functions of the utility commission should be comparable to those of a board of directors of a private corporation.

4. The utility commission should maintain personnel policies which are either in harmony with or a part of the policies maintained by the municipality. This is especially important with respect to such items as wage levels, collective bargaining, civil service and pension plans.

5. The funds of the utility should be kept separate from other funds of the municipality, and the disbursement of utility funds should be made in such a manner that both the municipality and the utility commission are kept currently informed of the financial condition of the utility.

Utility Funds

The separation of funds and the means of disbursement are so important that a description of a method frequently used in Wisconsin seems to be warranted. The utility board usually provides for its own treasurer or, in lieu thereof, provides that the treasurer of the municipality serve as fiscal officer for the board. Under this arrangement, payments on behalf of the utility board are made by warrants on the city treasurer, signed by the president and secretary of the utility board and countersigned by the city treasurer in his official capacity as treasurer for the municipality. The advantage of this method of procedure is that at all times the accounts of the utility and the city show all current orders or obligations drawn against them for which provision for payment must be made.

The general plan of independent management and control is further evidenced by the restrictions placed upon the use of utility funds by the Wisconsin statutes. The law provides that the income of a public utility owned by a municipality shall first be used to meet operating, maintenance, depreciation, interest and sinking-fund requirements; local and school tax equivalents; additions and improvements; and other necessary disbursements or indebtedness. Income in excess of these requirements may lawfully be used to purchase and hold interest-bearing bonds issued by the United States or any municipal corporation of Wisconsin or insurance upon the life of an officer or manager of the utility, or may be paid into the general fund. The statutes provide further that the funds derived from a *water* plant, over and above the operating and capital requirements just listed, may be used for sewerage construction work other than such as is chargeable against abutting property; or such funds may be used for general city purposes, or may be placed in a special fund for special municipal purposes. The latter statute dates back to 1913 and refers only to the disposition of water utility funds, thus indicating an early association between water utilities and the financing of sewerage systems. As nearly as can be determined, however, excess water utility funds in the past

have usually been turned over to the general fund rather than dedicated to the financing of sewerage systems or other special projects. The present legislature now has before it a bill which will enable town sanitary districts to combine water works, sewerage, and garbage and refuse disposal systems into a single unit and issue mortgage bonds against the unit payable solely from the revenues of the system. For towns, villages and cities, the combination is limited to water and sewerage systems. Legislative action on the bill will probably not be completed at the present session.

It is significant that the statutes permit the transfer of income from the utility to the municipality only after provision has been made for both operating expenses and various types of capital expenditures, some of which are not ordinarily classified as expenses. Thus, requirements for sinking funds, additions and improvements, debt reduction and other necessary disbursements are given priority over payments to the general fund. Strictly interpreted, no municipal utility could make payments to the general fund other than for taxes or for goods and services furnished to it by the municipality, unless it had no need for debt retirement or for additions and improvements. Few utilities, municipal or private, find themselves in such a condition for any extended period of time. These restrictions imposed by statute are much more severe than those normally applicable to the payment of dividends by private corporations and constitute an important link in the chain of efficient management. In the light of this statute, the commission has taken the view that payments of income into the general fund are equivalent to dividends on the common-stock equity of the municipality. If income is available in excess of the requirements of the statutes, such payments may be made to the municipality, even though the original funds, if any, advanced by it to the utility have been entirely repaid. There are a number of such instances in Wisconsin.

Payment of Taxes

The commission believes that municipal water utilities should be self-sufficient and that the water utility should therefore pay taxes to the municipality. The municipal utility is, in effect, a corporate citizen of the community, and, in common with other citizens, it benefits from various municipal services, such as police and fire protection. The statutes provide for setting up local and school tax equivalents. The commission suggests and allows the payment of taxes based upon the application of the combined local and school rate to an adjusted plant value. For this purpose, the plant value is computed by applying the ratio of assessed value of comparable industrial property to the full value of such property as determined by the state department of taxation. If the utility were privately owned, it would have to pay such taxes, as well as others. It seems appropriate that a water utility operated by a municipality in its proprietary capacity should contribute taxes to help support the municipality.

There is one rather unusual application of the taxing power which the statutes make available to municipal water utilities. Delinquent water bills may be placed upon the tax roll and thus, if they remain unpaid, become a lien on the property to which service

was furnished. This preferential treatment is accorded to municipal water utilities because of the intimate relationship of their product with public health and sanitation. The ordinary remedy of disconnection of service, if invoked, might conceivably threaten public health and sanitation beyond the confines of the premises which were disconnected.

Rate Policies

Because of the broad powers conferred upon it, the commission over a long period of years has had an opportunity to develop rate-making procedures, the propriety and soundness of which have withstood the test of time. Again the legislative philosophy as evidenced by the statutes has proved to be a bulwark in providing effective regulation.

Some of the basic principles employed either by reason of statutory requirement or promulgation of the commission are:

1. A municipally operated water utility is entitled to the same rate of return as that permitted for privately owned utilities.

2. "Free" service is unlawful and is prohibited, and no customer may be furnished service at a lesser rate than that charged others for like and contemporaneous service.

3. All services except public and private fire protection should be metered, and the meters should be owned and maintained by the utility.

4. The charge for public fire protection service should be determined on the basis of allocated costs, and should be billed to and paid by the municipality.

5. Rate schedules should be so designed as to distribute equitably the cost of service among the various classes of service, giving due consideration to the time, the rate and the quantity of use.

6. The utility should have on file and in effect such rules and regulations as may reasonably be applied to determine the utility's liability for financing extensions of general and fire protection service, and connection and tapping charges.

The statutes require that a publicly owned utility shall be entitled to the same rate of return as is permitted for privately owned utilities. Consequently, Wisconsin does not have the problem which sometimes arises when a municipality operates its utility in such a fashion as to obviate the necessity for levying local taxes. Such communities are widely advertised as "tax-free" and are held up as an example of the benefits of municipal ownership. Actually, this practice constitutes a disservice to the cause of municipal ownership because, in effect, it makes the utility the tax collector. Certainly, it would be a strange coincidence if the consumption of water established a proper base for levying a tax. Under such a scheme the utility is virtually levying a sales tax. The inequity of this policy is manifested by a number of municipal utilities which have attempted to charge customers excessive rates so that large appropriations could be made to the municipality, thus alleviating the taxes against property—including property to which no water service is furnished by the utility.

The rate of return permitted by the commission to water utilities, whether privately or municipally owned, is somewhat lower than that usually allowed for other utility services. This

differential has been established because of the relative stability of the revenues of water utilities, their low cost of capital and almost complete freedom from risk resulting from the indispensability of their product, and the lack of competition. The state supreme court has declared that it is permissible for a municipal water utility to collect a lesser rate of return from one class of service than from another, provided that the deficiency from one class is not made up by excessive or unreasonable returns from others. Under this policy, the commission has permitted some municipal water utilities to waive the rate of return from public fire protection service when such waiver was not used as a basis for increasing the rates and the rate of return from general customers.

Wisconsin has been one of the pioneers in the statutory prohibition of free utility service. *All* services rendered by a municipal water utility, as well as by all other utilities, are to be paid for under a schedule of rates which must be filed with and approved by the commission. There are no exceptions and no reduced rate service, except such as could be furnished by the waiver of all or part of the rate of return. Sewer flushing, street sprinkling, park watering, filling swimming pools, flooding skating rinks and furnishing water to fountains are all to be paid for at the lawfully filed rates. Whenever possible, such services are metered, and, in any event, the amount of water consumed is determined as accurately as possible and billed to the municipality at regular rates.

The commission has always insisted that, if possible, service must be metered and that the meters must be owned and maintained by the municipal water utility. The Wisconsin statutes provide that, unless otherwise ordered by the commission, the utility shall furnish the meters. In order to assist with the initial financing, the commission has sometimes granted temporary exemptions from the requirement of utility ownership of meters. Flat-rate service, which prevailed extensively in past years, has been discouraged because of the discrimination involved and because of the waste of water and uneconomical operation engendered. The commission has been particularly insistent that the total quantity of water supplied to the mains be metered. When this has not been done the commission has found cities where less than half of the water supplied to the mains was metered and billed to consumers. Metering at the source of supply is invaluable in assisting the utility to discover leaks and inaccurate consumer metering.

One of the most frequent causes of misunderstanding which the commission has met in its regulation of municipal water utilities is the method and basis for billing the municipality for fire protection service. This difficulty is principally attributable to the lack of a well defined unit of service. Many are prone to consider that the number of hydrants is indicative of a proper unit of service and all that is necessary is to establish an appropriate charge per hydrant. Proper consideration of the nature of the cost of service involved will show the fallacy of this approach. In effect, the hydrants are no more than individual taps, and the number may be large or small, depending upon local conditions. Two water systems comparable in all other

respects may differ widely as to the number of fire hydrants connected, although the extent of the fire protection furnished by the two systems is almost identical. The service that is furnished is the potential capacity of the pumps, mains and storage facilities to deliver water in sufficient quantities at adequate pressure. The number of hydrants connected is by no means a proper measure of such capacity. Over a long period the commission has developed means and methods whereby costs—including, for fire protection, principally fixed costs—can be allocated to the various classes of service furnished and a charge for fire protection established which is commensurate with such costs.

In a similar manner, the commission has had difficulty with customers who fail to appreciate the fundamental basis for establishing differential rates among consumers with varying characteristics. Frequently customers, and sometimes the utilities, argue that if the same quantity of water is used in a billing period, the charge should be identical, irrespective of the size of the service connection or the rate of use. The investment pattern of a water utility is determined by the size and extent of its physical facilities, which, in turn, reflect the cumulative requirements of all of the customers served. One customer over a short period of time may require as much water as another customer would use in a year. The pumping and main capacity needed to serve the large customers obviously is much greater than that for the small ones. A rate schedule which fails to give proper consideration to such factors is discriminatory and not in harmony with the cost of the service.

Main Extensions

The statutes permit municipally owned water utilities to assess the cost of main extensions and street laterals against the benefited property. When mains are of such size as to furnish fire protection service, an amount not to exceed one-half of the cost of an equivalent 6-in. main can be assessed against the abutting property. In order to equalize costs more nearly and to provide for greater simplicity, many municipal water utilities file extension rules which permit more liberal and uniform treatment of main extensions. Usually these rules provide for an extension without charge if its length does not exceed a specified number of feet per customer. When oversize mains are provided for fire protection service, only one-half of the cost beyond the free limit is charged against the customer. The installation of laterals between the main and the street line is practically always charged for at a uniform rate, to equalize costs between customers on the near side and those on the far side of the main.

The whole legislative philosophy and regulatory policy of Wisconsin on municipal water utilities is epitomized in the statement that, in all respects, municipal water utilities are treated as if they were privately owned except for certain considerations which are exclusively incident to municipal ownership.

Supposed Involvement of Water Supplies in Poliomyelitis Transmission

By Kenneth F. Maxcy

A paper presented on June 1, 1949, at the Annual Conference, Chicago, by Kenneth F. Maxcy, Prof. of Epidemiology, School of Hygiene and Public Health, Johns Hopkins Univ., Baltimore, Md. This study was aided by a grant from the National Foundation for Infantile Paralysis.

EVIDENCE regarding the mode of communication of poliomyelitis has now been accumulated over many years by epidemiological observations and by laboratory experiments. It has been checked from many angles and by many investigators (1, 2). The only known natural sources of the causative virus are the oropharyngeal secretions and fecal excretions of infected human beings. In a large proportion of individuals this infection is not manifested by a clinical pattern which can be recognized; only in the occasional individual does it result in the characteristic paralytic disease. The ratio of inapparent infections, or carriers, to recognized cases varies but may at times be of the order of 100:1. It is this characteristic which lends mystery to the spread of the disease and limits the value of quarantine measures. The infectious period is brief, usually a matter of a few days. To maintain chains of transmission in human populations, material from infected persons must be progressively transferred and reach the alimentary tract of exposed susceptible individuals. Exactly in what manner this transfer is effected is not entirely clear, but the requisite conditions are included in the implications of the term "intimate personal association" and are realized in the communal living of any social group, from the primitive to the most advanced, at any time of the year, in any part of the world. The conditions are not essentially different from those required for the propagation of other common contagious diseases.

The concept that the principal mode of communication of poliomyelitis is some form of personal contact is no longer just a theory; it should be regarded as an established fact. This concept is adequate to explain all of the known observations on the epidemiological distributions and characteristics of the disease. No other theory so far proposed fits all of the observations equally well. This fact, however, does not preclude the possibility that accessory and indirect routes of spread may be operative under special circumstances.

Spread of Virus

Four such possibilities have received attention and have been extensively explored: [1] the existence of an extrahuman reservoir of the virus; [2] the role of flies as vectors; [3] dissemination by contaminated milk; and [4] dissemination by polluted water supplies. Before proceeding to the consideration of the latter, which is the principal concern of this discussion, it

is appropriate to refer briefly to the present status of knowledge regarding the other three.

Up to the present, no extrahuman source of poliomyelitis virus strictly defined (3) has been found. Much speculation and a considerable amount of work have been directed toward the discovery of a natural host to the virus other than man (4). The search has ranged through many species of animals, birds, fish and arthropods, but so far it has been unproductive, except for the observation on flies. The hypothesis that flies are implicated in transmission is attractive because the season of highest prevalence of the disease, like that of such enteric diseases as typhoid fever and bacillary dysentery, corresponds roughly with that time of the year when flies are most numerous.

Upon many occasions investigators have recovered poliomyelitis virus from pools of flies collected in localities where cases of the disease were occurring (5). Five species have been incriminated: *Phormia regina* (black blow fly); *Phaenicia sericata* (green bottle fly); *Musca domestica* (house fly); *Sarcophaga spp.* (flesh fly); and *Cynomyopsis cadaverina* (blue bottle fly). Experimental work done up to the present has failed to demonstrate multiplication of the virus within the tissue cells of any of these flies, with the possible exception of one observation on *Phormia regina* (6). More work is required, but until contrary evidence is forthcoming it must be assumed that the virus found in or on flies captured about human habitations is human in origin rather than resultant of growth within the insect itself.

All five species of flies may feed upon human excrement and may thus be contaminated. Only one species, *Musca domestica,* freely enters houses. Suggestive is the finding that, when fed to chimpanzees, foods exposed to flies in a North Carolina epidemic produced asymptomatic infection in the animals (7). It is still an unresolved question whether flies under natural conditions feed upon human excrement and subsequently enter houses to contaminate food sufficiently often to constitute a route of dissemination of any practical importance. Studies directed toward an answer to this problem are under way. Quite obviously, if flies do play any role in transmission, it can only be an accessory one, and its relative importance will vary enormously with climate, season, sanitation and other factors.

With every outbreak of poliomyelitis which occurs in the United States, the possible implication of a common milk supply receives consideration. In addition to the three outbreaks attributed to the consumption of raw milk which appeared in the literature prior to 1928, there have been two recent reports (8, 9) of small focalized epidemics in which contamination of milk was a possible explanation. In general, however, with accumulating experience, evidence incriminating this medium of dissemination is conspicuous by its absence.

In considering the role of polluted water in the dissemination of poliomyelitis, it should be specified that the present paper is not concerned with transmission which may take place around a household by contamination of a private well, spring or container through improper sanitary arrangements, or by use of a common bathtub, nor with transmission resulting from community use of the enlarged bathtub known as a swimming pool.

Statement of Problem

The present concern is with the possibility that the pollution of community water supplies may be responsible in some measure or occasionally for indirect and widespread exposure of consumers to infection with the virus. Some years ago, an effort was made to assemble and evaluate critically the information available (10–12). Since then there have been many investigations which have a bearing upon this subject. It is timely, therefore, again to take stock of current knowledge in an effort to arrive at an informed and sound judgment about the matter.

The evidence bearing upon this hypothesis has been adduced along four lines: [1] the recovery of the virus from domestic sewage; [2] attempts to recover the virus from water supplies; [3] effect on the virus of procedures employed in water purification; and [4] the epidemiological observations associating the occurrence of cases with water distribution systems.

Recovery of Virus From Sewage

With appreciation of the fact that the virus was commonly present in the feces of infected persons, and that the infection is far more widely distributed in a population than is indicated by the occurrence of paralytic cases alone, it was to be expected that it would be found occasionally in domestic sewage. In 1939 Paul, Trask and Gard (13) succeeded in detecting poliomyelitis virus in raw sewage during epidemics in Charleston, S.C., and in Detroit, Mich. Their work was confirmed by Kling (14) and his group, who isolated the virus from a sewage sample collected during the 1939 epidemic in Stockholm, Sweden, and sponsored the idea that sewage should be considered an important source of infection by which the agent could be transported over long distances. Developing more sensitive and reliable methods of detection, New Haven investigators made a series of observations, the results of which were summarized by Melnick (15) in 1947 and have been extended by Gear and his associates (16, 17) in Johannesburg, Union of South Africa, and by Francis and his colleagues (4) in the United States. In brief, these studies have shown that the virus of poliomyelitis may be recovered occasionally:

1. From the raw sewage of hospitals during a period when poliomyelitis patients are being treated
2. From raw sewage taken from mains in residential areas in which paralytic cases are not known to be occurring, but during a period when the disease is known to be present in other parts of the same city
3. From raw sewage taken from large mains or the influent of a treatment works during a period when the disease is epidemic in a community and for a short time thereafter
4. From early stages in the disposal process—less frequently in the effluent of a sewage treatment plant during epidemic periods.

Attempts to recover the virus from treated sludge and from soil of agricultural land irrigated by polluted water have been unsuccessful. Incidentally, it was not detected by Gear and his colleagues (16, 17) in psychodid flies from the sprinkler bed nor in the fecal droppings of swallows hawking insects in the neighborhood of the sewage works.

One of the most important questions raised with regard to the finding of this virus in sewage is whether its presence in this medium is due to its ability to grow and multiply in some one of the simple biological forms

with which the sewage is teeming. That the virus could only be detected during periods when the disease was prevalent in the contributing population spoke against this concept. Nevertheless, Evans (18) explored this hypothesis and carried out experiments over a number of years designed to test the ability of this virus to grow in the protozoa of sewage. The results were negative. He concluded finally, from quantitative estimates, that the findings in sewage are compatible with what might be expected on the basis of fecal contributions from cases and carriers and the degree of sensitiveness of the methods used for isolation and identification of the virus by inoculating concentrates into monkeys.

It appears, therefore, from the studies made thus far, that while the virus may occasionally be demonstrated in raw sewage during epidemic periods and may survive in sufficient quantities to permit detection during some stages of the treatment processes—and even in the effluent—it has not been traced beyond this point in the external environment. The findings can have significance in relation to the spread of the disease only if it can be demonstrated that the virus in sewage can again ultimately reach the human alimentary tract. Another link in the chain is necessary. Obviously, one means by which it could be supplied is through the survival of sufficient quantities of the virus in sewage—particularly if discharged without treatment—to reach and pollute surface or underground waters which are used by some community for drinking or bathing purposes, and to be consumed in infective doses by human beings.

Attempted Recovery From Water

Granting the possibility that such pollution might happen occasionally, there have been many attempts to recover the virus from samples of water collected from suspected supplies. Carl Kling (19), foremost exponent of the *théorie hydrique*, working in the state bacteriological institute in Sweden, for several years tested samples of water from supplies which he thought, from epidemiological observations, might be involved in transmission. In one instance the result of a monkey inoculation was regarded as positive. The evidence submitted that the inoculated animal had poliomyelitis is not entirely satisfactory according to the criteria now demanded for identification. The same qualification must be placed upon the report of Toomey, Tacaks and Weaver (20) that they had isolated the virus of poliomyelitis from polluted creek water by direct inoculation of a concentrate into a cotton rat. Recently, Francis *et al.* (4) reported the results of inoculating monkeys with concentrates of samples of water from lakes, rivers, ponds and city supplies near epidemic areas in Cleveland and Akron, Ohio; Fort Worth, Texas; and several small towns of Michigan. All were negative.

Up to the present, therefore, attempts to demonstrate the virus of poliomyelitis by laboratory methods in water used for community drinking purposes have not been productive. The studies are comparatively few in number, however, and represent a very limited experience. The methods at present available for the recovery of the virus—depending upon concentration, ether treatment to remove bacteria and intranasal or intraperitoneal inoculation of monkeys—are cumbersome, time consuming and expensive. That quantities of virus sufficient to infect human beings might not be detected by these methods is a doubtful possibility,

but it cannot be completely ignored. The question has been legitimately raised, therefore, as to whether the standard procedures of water treatment and purification, which have been found adequate for the removal of bacteria from a heavily polluted source, are equally effective in the removal or inactivation of a virus such as that which causes poliomyelitis. *A priori* there is no reason to believe that the conventional *Esch. coli* index of safety is applicable in this relationship.

Effect of Purification Procedures

The question of the effect on the virus of water purification procedures was approached in the experimental laboratory in 1942 by Carlson, Ridenour and McKhann (21) and Kempf *et al.* (22). The investigators contaminated city water or raw water with large quantities of nervous-tissue suspensions containing the virus and simulated in the laboratory on a small scale the conditions of coagulation and sedimentation, sand filtration, absorption on activated charcoal, storage and aeration. It was concluded that these procedures (when tested individually, but not in series as is the practice in water treatment plants) failed to remove the virus completely from artificially heavily contaminated water, as judged by infectivity tests in mice and monkeys.

From these early exploratory experiments with an artificial laboratory setup, the inference was drawn by many readers that the procedures used in the physical and chemical treatment of raw water, which are sufficient to produce a relatively satisfactory product from the point of view of removing most of the bacteria, may not be effective in eliminating or inactivating the virus of poliomyelitis. However, these experiments only pose a question and leave much to be desired in the way of additional testing under conditions more closely simulating those naturally encountered in water plant operations, before reliable conclusions can be drawn. At the same time the tests also point up a dependent question—whether any virus which might survive such treatment procedures would be finally inactivated by chlorination as ordinarily practiced.

In the early experiments (22) suspensions of spinal cords from infected monkeys were mixed with samples of river and tap water which contained residual chlorine or which were chlorinated in the laboratory. The concentration of total chlorine was determined by the ortho-tolidine or starch-iodide methods. After varying intervals of time aliquots were tested by animal inoculation for the presence of active virus. From a series of tests of this kind, it was concluded that a chlorine application to produce residual chlorine concentrations of the order of 1.0–1.5 ppm. or more, after a contact time of about one-half hour, was required to inactivate the virus (in the presence of unspecified amounts of inorganic matter). It was pointed out that these concentrations of chlorine are in excess of those recommended for the production of bacteriologically safe drinking or swimming pool water. This observation led Zichis and Piszczek (23), in 1948, to the statement that "the safety factor provided against bacteria through chlorination of water does not seem to apply to viruses." In brief, the Zichis-Piszczek studies were made with poliomyelitis (Lansing strain), western equine encephalitis, St. Louis encephalitis and lymphocytic choriomeningitis. The source of the viruses used in these experiments was emulsions of infected mouse brains. Municipal drinking (tap) water con-

taining "about 0.1 ppm. of chlorine" was used for suspending the viruses. The method for determining the concentration of chlorine is not given. In each experiment, the brain tissue virus emulsion was diluted 1:5,000, and subsequently samples were taken at intervals of time and inoculated into mice. On the basis of observations made under these highly artificial experimental conditions, the inference was drawn that "when these viruses were suspended in chlorinated drinking water . . . and retained at room temperature, they remained infectious for several days." Obviously, this inference is equivocal and misleading.

The implications of these very limited studies were most disturbing. They have received wide publicity and created considerable anxiety—an anxiety which appears to be unjustified in the light of later, more careful investigations taking into account the mechanisms of action of chlorine upon microorganisms in the presence of large amounts of organic matter experimentally introduced by the use of brain and cord emulsions as a source of virus. In 1946 it was pointed out by Ridenour and Ingols (24) that conclusions regarding virucidal activity based upon the use of either the ortho-tolidine or the starch-iodide test for the amount of residual chlorine may be fallacious, since neither test differentiates between the forms in which chlorine can exist in water. This differentiation is important because free available chlorine may be more effective than combined available chlorine as a virucidal agent. The concentration of free chlorine can be measured by the ortho-tolidine-arsenite test.

On the basis of their experiments, Ridenour and Ingols (24) concluded that a free chlorine residual of approximately 0.2 ppm. will inactivate a 1:500 dilution of mouse cord suspension containing Lansing virus after a period of contact of ten minutes. Their observations were confirmed and extended by Lensen, Rhian and Stebbins (25). These investigators worked with virus suspensions which had been partially purified. Extraneous organic material had been largely removed by differential centrifugation so that the nitrogen content of the virus suspension used for the chlorination experiments was comparable with that of natural waters used as a source of municipal supplies. The concentration of virus activity in the portions of water tested varied in most of the experiments from approximately 5 to 30 times that of the LD_{50} concentration, as estimated by intracerebral inoculation of mice. The pH of the samples varied from 7.0 to 7.4 and the temperature from 21° to 25°C. It was concluded that under these conditions the virus was inactivated in less than half an hour in suspensions containing residuals as low as 0.2 ppm. free chlorine plus 0.2 ppm. chloramine.

In a later series of experiments, Lensen, Rhian and Stebbins (26) attempted to define the effect of residual concentrations of chloramines, in the presence of minimal amounts of free chlorine, upon the survival of the virus after varying periods of time at the same and at a higher pH range (8.95–9.25). Although there were certain irregularities and inconsistencies in their experimental results, they were interpreted as indicating that residual chloramine values of 0.5–0.75 ppm. usually inactivate the virus in less than two hours.

While further carefully controlled studies are desirable, on the basis of experimental results now available, it appears to the author that the application of chlorine under conditions which

will insure the maintenance of 0.2–0.3-ppm. free available chlorine residuals after one-half hour of contact may be sufficient to inactivate the quantities of poliomyelitis virus that might be present in a potable water. Such residuals are already being maintained in many water purification plants. This conclusion is comforting reassurance, but it in no way establishes an implication as to the need for this safeguard or the magnitude of the risk involved.

Neither the failure to detect the virus of poliomyelitis in drinking water nor the possible failure of common purification procedures to remove or inactivate it, when it is artificially introduced, can answer the principal question proposed above: that is, are there times when the virus present in sewage may survive conditions of natural and artificial purification, reach a finished water supply and be distributed in infective dosage to a human population? This question can only be answered by epidemiological evidence.

Epidemiological Observations

In a previous paper (10), published in 1943, the nature of the evidence which is required to establish a reasonable presumption that a disease is waterborne has been delineated. In general, all of the facts and observations on the manner of occurrence and the distribution of cases in time, place and persons must be consistent with the hypothesis of dissemination by the suspected water distribution system and no other explanation must be equally valid. In the 1943 paper (10), the literature on poliomyelitis was reviewed and evidence of this character was found to be lacking. In the six years which have elapsed since that publication there have been numerous reports of investigations of the occurrence of poliomyelitis in various areas of this country and in other parts of the world. In many of these, particular consideration has been given to the possible role of water supplies. In only one report has the investigator argued that sewage pollution of a water system was responsible for the spread of poliomyelitis. Reference is made to Carl Kling's account (19) of two small outbreaks in Sweden. The evidence which he presents in support of his explanation is plausible but far from convincing. It consists very largely of observations on the occurrence of groups of cases along watercourses (lakes, rivers and brooks) into which sewage is discharged, and of Kling's belief—based upon the 1942 laboratory experiments of Carlson, Ridenour and McKhann (21) to which reference has been made above—that the treatment of these surface waters by filtration through sand (no details given), which was satisfactory by bacteriological tests, was insufficient to remove viruses.

Influenced by Kling's arguments, Wenner (27) made an analysis of the distribution of cases of poliomyelitis which had been reported in Connecticut during the decade 1931–41. He was unable to demonstrate excessive prevalence in the areas traversed by four large rivers into which a constantly increasing load of domestic sewage was being discharged.

Others who have investigated outbreaks of poliomyelitis in recent years have invariably come to the conclusion that the manner in which cases were distributed, the progressive radial spread from foci of infection, the buildup and decline of the epidemic curve, and other features were not consistent with the hypothesis of dissemination by a common water supply. The report of Seddon *et al.* (28) on the epidemics which occurred on

the islands of Malta and Gozo during the winter of 1942–43 was particularly conclusive in this regard. Many similar experiences could be cited, but space does not permit a detailed review.

It is still true now, as was stated in 1943, that there is on record not a single explosive outbreak of this disease which has been conclusively shown to be due to the simultaneous exposure of a group of people to a common water supply. If poliomyelitis were waterborne, surely one would expect that such an accident would have occurred somewhere at some time and that the event would have been discovered and reported in the same manner as have such outbreaks of typhoid fever.

In brief, up to the present, there is no epidemiological evidence to support the supposition that occasionally the virus in sewage may survive the conditions of natural and artificial purification, reach common drinking water supplies and be distributed in infective dosage to the consumers.

Summary

The occasional finding of the virus of poliomyelitis in domestic sewage during a period of high prevalence is without significance in the transmission of the disease, unless or until it can be shown through what channels the virus from this source may reach the alimentary tract of human beings. So far the virus has not been traced beyond the effluent from sewage treatment works. That it may occasionally survive the conditions which effect natural purification in rivers and lakes and reach the intake of a water system is a theoretic possibility only. Up to the present, attempts to demonstrate the virus in suspected drinking water supplies are questionable or negative. It is unknown whether, if present in raw water at the intake of a surface supply, it would be removed by the successive stages of treatment necessary to produce a potable product which is safe by bacteriological standards. However, free residual chlorination, as customarily practiced, affords an adequate safeguard.

Although a large number of epidemiological studies of the prevalence and distribution of poliomyelitis have been made during the past half century, there is no instance on record up to the present in which convincing evidence has been presented that pollution of a community water supply was responsible for indirect and widespread exposure of consumers to infection with the virus.

While continued investigation of the effect of standard practices in water purification upon the removal or inactivation of specified viruses is eminently desirable, there is no reason whatever to expect that improved methods of treatment will have any effect upon the prevalence of poliomyelitis.

References

1. Howe, H. A. The Epidemiology of Poliomyelitis in the Light of Modern Research. Am. J. Med., **6**:537 (May 1949).
2. Ward, R. Poliomyelitis: A Review of Its Natural History. Pediatrics, **1**: 132 (Jan. 1948).
3. A Proposed Provisional Definition of Poliomyelitis Virus. Science, **108**:701 (Dec. 1948).
4. Francis, T., Jr.; Brown, G. C. & Penner, L. R. Search for Extrahuman Sources of Poliomyelitis Virus. J.A.M.A., **136**:1088 (April 1948).
5. Melnick, J. L. Isolation of Poliomyelitis Virus From Single Species of Flies Collected During an Urban Epidemic. Am. J. Hyg., **49**:8 (Jan. 1949).

6. ——— & PENNER, L. R. Experimental Infection of Flies With Human Poliomyelitis Virus. Proc. Soc. Exp. Bio. and Med., **65**:342 (1947).
7. WARD, R.; MELNICK, J. L. & HORSTMANN, D. M. Poliomyelitis Virus in Fly-contaminated Food Collected at an Epidemic. Science, **101**:491 (1945).
8. GOLDSTEIN, D. M.; HAMMON, W. McD. & VIETS, H. R. An Outbreak of Polioencephalitis Among Navy Cadets, Possibly Foodborne. J.A.M.A., **131**: 569 (June 1946).
9. MATHEWS, F. P. Poliomyelitis Epidemic, Possibly Milkborne, in a Naval Station, Portland, Oregon. Am. J. Hyg., **49**:1 (Jan. 1949).
10. MAXCY, K. F. Hypothetical Relationship of Water Supplies to Poliomyelitis. Am. J. Pub. Health, **33**:41 (Jan. 1943).
11. ——— & HOWE, H. A. The Significance of the Finding of the Virus of Infantile Paralysis in Sewage: A Review. Sewage Works J., **15**:1101 (Nov. 1943).
12. KROMBIEGEL, E. R. Transmission of Virus Diseases by Water. Jour. A.W.W.A., **36**:81 (Jan. 1944).
13. PAUL, J. R.; TRASK, J. D. & GARD, S. Poliomyelitis Virus in Urban Sewage. J. Exptl. Med., **71**:765 (June 1940).
14. KLING, C. ET AL. Sewage as a Carrier and Disseminator of Poliomyelitis Virus; Searching for Poliomyelitis Virus in Stockholm Sewage; Studies on the Conditions of Life of Poliomyelitis Virus Outside the Human Organism. Acta Med., Scandinav., **112**:217 (1942).
15. MELNICK, J. L. Poliomyelitis Virus in Urban Sewage in Epidemic and Non-epidemic Times. Am. J. Hyg., **45**:240 (March 1947).
16. GEAR, J. H. S.; MUNDEL, B. & WILSON, D. The Isolation of the Virus of Poliomyelitis From Sewage in Johannesburg. S. Afr. Med. J., **20**:139 (March 1946).
17. MUNDEL, B.; GEAR, J. H. S. & WILSON, D. The Distribution of the Virus of Poliomyelitis in a Sewage Purification Works in Johannesburg. S. Afr. Med. J., **20**:336 (June 1946).
18. EVANS, C. A. Does Poliomyelitis Virus Grow in Sewage? Acta Med., Scandinav., **126**: fasc. VI (1947).
19. KLING, C. Le rôle des eaux d'égout comme disseminateur du virus poliomyelitique. Presse Medicale, **55**:848 (Dec. 1947).
20. TOOMEY, J. A.; TACAKS, W. S. & WEAVER, H. M. Isolation of Poliomyelitis From Creek Water by Direct Transmission to the Cotton Rat. Am. J. Dis. of Child., **70**:293 (1945).
21. CARLSON, H. J.; RIDENOUR, G. M. & McKHANN, C. F. Efficacy of Standard Purification Methods in Removing Poliomyelitis Virus From Water. Am. J. Pub. Health, **32**:1256 (Nov. 1942).
22. KEMPF, J. E. ET AL. Effect of Aluminum Hydroxide Sedimentation, Sand Filtration and Chlorination on the Virus of Poliomyelitis. Am. J. Pub. Health, **32**:1366 (Dec. 1942).
23. ZICHIS, J. & PISZCZEK, E. A. Duration of Viability of Neurotropic Viruses in an Experimental Plumbing System Contaminated by Back Siphonage. Science, **108**:503 (Nov. 1948).
24. RIDENOUR, G. M. & INGOLS, R. S. Inactivation of Poliomyelitis Virus by "Free" Chlorine. Am. J. Pub. Health, **36**:639 (June 1946).
25. LENSEN, S. G.; RHIAN, M. & STEBBINS, M. R. The Inactivation of Partially Purified Poliomyelitis Virus in Water by Chlorination. Jour. A.W.W.A., **38**:1069 (Sept. 1946).
26. ———. The Inactivation of Partially Purified Poliomyelitis Virus in Water by Chlorination. Am. J. Pub. Health, **37**:869 (1947).
27. WENNER, H. A. An Ecologic Study of Poliomyelitis in Connecticut, 1931–1941. Yale J. Bio. and Med., **15**:707 (1942–43).
28. SEDDON, H. J. ET AL. The Poliomyelitis Epidemic in Malta, 1942–43. Quart. J. Med., **14**:1 (Jan. 1945).

Planning for Future Development

By Melvin P. Hatcher

A paper presented on April 21, 1949, at the Indiana Section Meeting, Indianapolis, Ind., by Melvin P. Hatcher, Director, Water Dept., Kansas City, Mo.

THE management of a water works property is less alert than it should be for its own good and is not living up to what its community has a right to expect of it, if it is not adequately prepared for the future. It should know the bottlenecks in its physical property; it should know in about what order it will be necessary to overcome them; and it should be ready with final plans when the improvements are needed. It should, in a sense, have a master plan for the development of the property.

Increased Demand

The foundation for master planning must be an estimate of future water demands. This estimate will be affected by increases in population and in the use of water per capita. Both of these factors have been at work in most cities during and since the war, and there is evidence that the former will decrease and the latter increase.

Just before the war experts on population trends were saying that the trend of increases in population would be retarded. In the first 30 years of this century the population rise for the nation averaged 2.25 per cent per year. It was said that the increase for the 50 years after 1930 would be on the order of about 0.5 per cent per year. Since 1940 the rate of increase has been near an average of 1.5 per cent annually, which is due in part to unusually favorable civilian mortality during the war years but is mostly attributable to the so-called "baby boom" of that period. Because of a general shift from rural to urban centers that has been going on for some years and was accelerated in wartime, many cities have continued rather high rates of growth during the current decade in excess of the national average.

The Census Bureau, however, warns in a recent publication (1): "Plans for community expansion will need to be scrutinized more carefully in the future than in the past, for there will no longer be the same assurance of a continued growth. There will be less justification for public officials to construct permanent or semipermanent facilities, such as schools, water supplies and sewer systems, in excess of the needs of the next few years."

Air conditioning is another factor having increasing influence on water use trends. The population of Kansas City has increased approximately 10 per cent since 1940 but water consumption has increased by about 30 per cent. It is believed that water used in air conditioning accounts for an appreciable part of this disparity between population and water use increase. Kansas City has approximately 35,000 tons of installed capacity of comfort cooling equipment, of which 20 per cent was installed in the last year. About half

of the total tonnage makes use of water conservation devices; in the other half, the cooling water is wasted to the sewer. From preliminary studies of the air-conditioning demand for water, it appears that 5 per cent of Kansas City's water is used for this purpose but that air conditioning accounts for 12.5–15 per cent of the maximum daily demand.

Essentials of Planning

A good part of what is said here about master planning for water works properties will apply as well to small as to large properties, in the sense that any growing property needs to anticipate the demands to be imposed upon it and must be ready when the time comes to meet those demands. However, the manner in which the planning is carried out and, to some extent, the scope of the planning will be affected by the size of the property.

The smallest properties need to see to it that the capacity of their production facilities and their distribution systems keeps pace with the demand. It is likely that consulting engineers will plan the improvements for the properties when they are made. Master planning by the management of these utilities will include, then, mainly the anticipation of their requirements and, more important, the provision of records of the kind the consulting engineer will need in the formulation of plans for the improvements. All properties ought to have records from which it would be possible to develop a duration curve showing the rate of water delivered to the distribution system by percentage of total time. Also, all properties should have meter records that would show the consumption of water by location with respect to the distribution system. Such data is essential to a Hardy Cross analysis of the distribution system. If there is need for improvements to the distribution system, the management for the property should see to it that data are gathered during periods of peak demand. This information should include, for instance, a record of the rates of flow into the distribution system by hours of the day, coupled with records of the use of water from storage and of the residual pressures at critical points in the system.

Water works properties large enough to include engineers on the staff, or having an engineer in a managerial capacity, can do a somewhat better job of master planning. They should accomplish as much as their engineering talent and time will permit in the anticipation of major changes in their supply facilities even though they may plan evertually to turn the actual designing over to a consulting engineer. They will improve the chances of a proper design if they see to it that the consulting engineer's needs for basic data are anticipated. This statement applies, for example, to those systems using river supplies not regularly gaged for stream flow.

Management should be acquainted with the bottlenecks in existing property. It must be borne in mind that the capacity of a system may be affected adversely by some one link in the whole capacity chain—perhaps the main between the principal plant and the distribution system or the line between an elevated tank and the distribution system. Or the capacity of a treatment plant may be limited by its interconnecting piping.

The Hardy Cross method of water distribution analysis has improved the effectiveness of master planning for this part of a water works property. It is possible with this method to picture the

effect of a maximum system demand in terms of the residual pressure throughout a distribution system. The distribution of this maximum demand to points within the system must be premised on the meter readings for the various customers attached to the system. Kansas City maintains a continuous record of water consumption by meter book areas (200 to 300 customers) in order to be able to watch the growth trends by districts. Kansas City also maintains 43 recording pressure gage stations. These data were of inestimable value in a Hardy Cross analysis made in 1943.

It is particularly important for water utilities to have a master plan for trunk main extensions into new territory. A property should be prepared for growth in any direction because there is seldom enough time for proper planning once some realtor has completed his scheme for the development of a particular tract. Master planning of this kind will make it possible for the utility to anticipate water main location problems involving new thoroughfares and structures, as well as the need for pumping or storage sites.

Finally, master planning should be applied to the water rate problems. A consumer analysis—a statement that will show the number of consumers using various quantities of water per month—is essential to a rate study. Kansas City is so convinced of the value of such records that it has complete data for a four-year period to date although it has no definite plans for a change in rates. Moreover, it is continuously studying the usage of water for air conditioning and lawn sprinkling and the demands of various classes of industry. Kansas City believes that an understanding of the use of water by its customers is a very important part of its master planning.

Reference

1. Whelpton, P. K. Forecasts of the Population of the United States, 1945–1975. U.S. Census Bureau, Washington, D.C. (1947).

This Month's Cover

The fearsome foursome pictured on this month's cover represents a random selection from the rogues' gallery of water supply pests assembled by George Turre, sanitary engineer of the Denver, Colo., water board. With the summer algae season in full bloom, the various forms of vexatious vegetation here put on the spot by Turre's photomicrographs are among those guilty in the taste and odor case.

Incidentally, we should give warning that the reproduction in blue is accurate only insofar as it expresses the emotions of the water works man who looks at Turre's Terrors; the Diatomaceae (*Asterionella* and *Synedra*) are usually brownish in color; the Cyanophyceae (*Anabaena*), blue-green; and the Chlorophyceae (*Pediastrum*), green. Too, we should point out that the *Asterionella* pictured is not overcelled, but looks that way because it was caught in the process of reproduction.

Water Supply Problems in the Chicago Metropolitan Area

By Loran D. Gayton

A paper presented on May 30, 1949, at the Annual Conference, Chicago, by Loran D. Gayton, Asst. City Engr., Dept. of Public Works, Chicago.

IN the Chicago metropolitan area, the municipalities bordering on Lake Michigan have a practically unlimited source of supply from that body of water. The water supply problems of these cities are caused by the growing demand for water and the ever increasing cost of meeting that demand. Many communities have found it necessary to increase water rates in order to meet the rising costs of operation.

On the other hand, the inland municipalities in the area depending on well water supplies have for many years been faced with the problem of a continuously receding sandstone water level. This recession has made necessary the lowering of pumps, resulting in increased pumping costs and often an unsatisfactory quality of water.

In a 1948 report of the Illinois State Water Survey Div., A. M. Buswell, the division chief, stated (1):

> For more than 40 years men have been studying ways to distribute Lake Michigan water throughout the metropolitan region. These studies are too numerous to summarize here, but each has concluded that it is desirable to make lake water available throughout the region.
>
> Distribution of the lake water to many communities in the region is entirely feasible. The principal obstacles to progress of the work are the difficulty of unifying the desires of the numerous communities involved and the desire of each to avoid domination by a larger political agency.
>
> It is in the interest of the whole state to foster the distribution of lake water in the region, for such a water supply would be of better mineral quality than most of the ground waters used. The lake supply would also be permanent, whereas many of the ground water resources are receding to the point where they are becoming costly. Promoting the welfare of half of Illinois' population aids the whole state.

Oscar E. Hewitt, Commissioner of Public Works of Chicago, has given a great deal of thought and study to the matter of a metropolitan water supply system for the Chicago area. He is convinced that the inland municipalities must eventually come to Lake Michigan for a dependable water supply, and that the logical and economical solution of their problem is an extension of the Chicago water supply system to make Lake Michigan water available to them. Commissioner Hewitt's plan for such an extension is outlined later in this paper.

Chicago Metropolitan Area

As used in this study, the Chicago metropolitan area is the region within a radius of 40 miles from the intersection of State and Madison Streets in Chicago. This assumed metropolitan area reaches from Waukegan, Ill., on

the north to Gary, Ind., on the south; as far west as the cities of Elgin and Aurora, Ill.; and southwest to Joliet, Ill. In this area there were, as of 1940, 168 incorporated cities, towns and villages, and 25 unincorporated villages, making a total of 193 communities (*see* Fig. 1).

Chicago stretches for 20 miles along the Lake Michigan shoreline, approximately north and south, and at certain locations it reaches back approximately 10 miles from the shoreline. It covers an area of approximately 212 square miles. The main branch of the Chicago River enters Lake Michigan at a point almost exactly midway between the north and the south limits of the shoreline.

The central business district of the city, or the so-called Loop area, reaches from Chicago Avenue on the north to 12th Street on the south, a distance of approximately 2 miles, and from the Lake Shore on the east to the south branch of the Chicago River on the west, or approximately 1 mile. This central business district is built up almost solidly with commercial and office buildings of the skyscraper type.

From Chicago Avenue to the northern city limits and from the Lake Michigan shoreline to the western city limits is in general a residential area, broken here and there by local community business centers. Directly west of the business center of the city is a section made up partly of manufacturing, partly of commercial and partly of residential structures.

Reaching from 12th Street southward along the shoreline to 79th Street —a distance of approximately 8 miles —and westward from the shoreline to the city limits, is an area that is in general residential, although dotted with manufacturing establishments, industries (such as the Union Stock Yards) and numerous community business centers.

From 79th Street southward to the city limits at 138th Street—a distance of approximately 7 miles—and spreading east and west for approximately 5 miles, is one of the world's greatest industrial areas, the Calumet industrial district, with its huge steel mills, car works and docks. In addition, an almost continuous industrial and manufacturing area stretches along both banks of the north branch of the Chicago River, and also on the Chicago Sanitary Dist. Canal across the city to the southwest. In general, it can be said that Chicago's industrial and manufacturing areas lie south of Chicago Avenue and reach clear to 138th Street, extending from close to the lake shore westward to the city limits. This whole area is covered by a network of railroads with numerous terminals and switching yards.

Northward from the Chicago city limits, along the shoreline to Waukegan, are numerous high-class residential communities with practically no industries, although Waukegan itself does have some large industries. To the northwest, west and southwest of Chicago, and lying within a radius of 20 miles from the intersection of State and Madison Streets in Chicago, are numerous small residential communities with little or no industrial occupancy. Beyond the 20-mile but within the 40-mile circle, is found mostly rich farming land with small, widely separated community centers.

South of Chicago, along the Indiana shoreline to Gary, is a continuation of the Calumet industrial district, with huge steel mills, cement plants and oil refineries. To the south of the In-

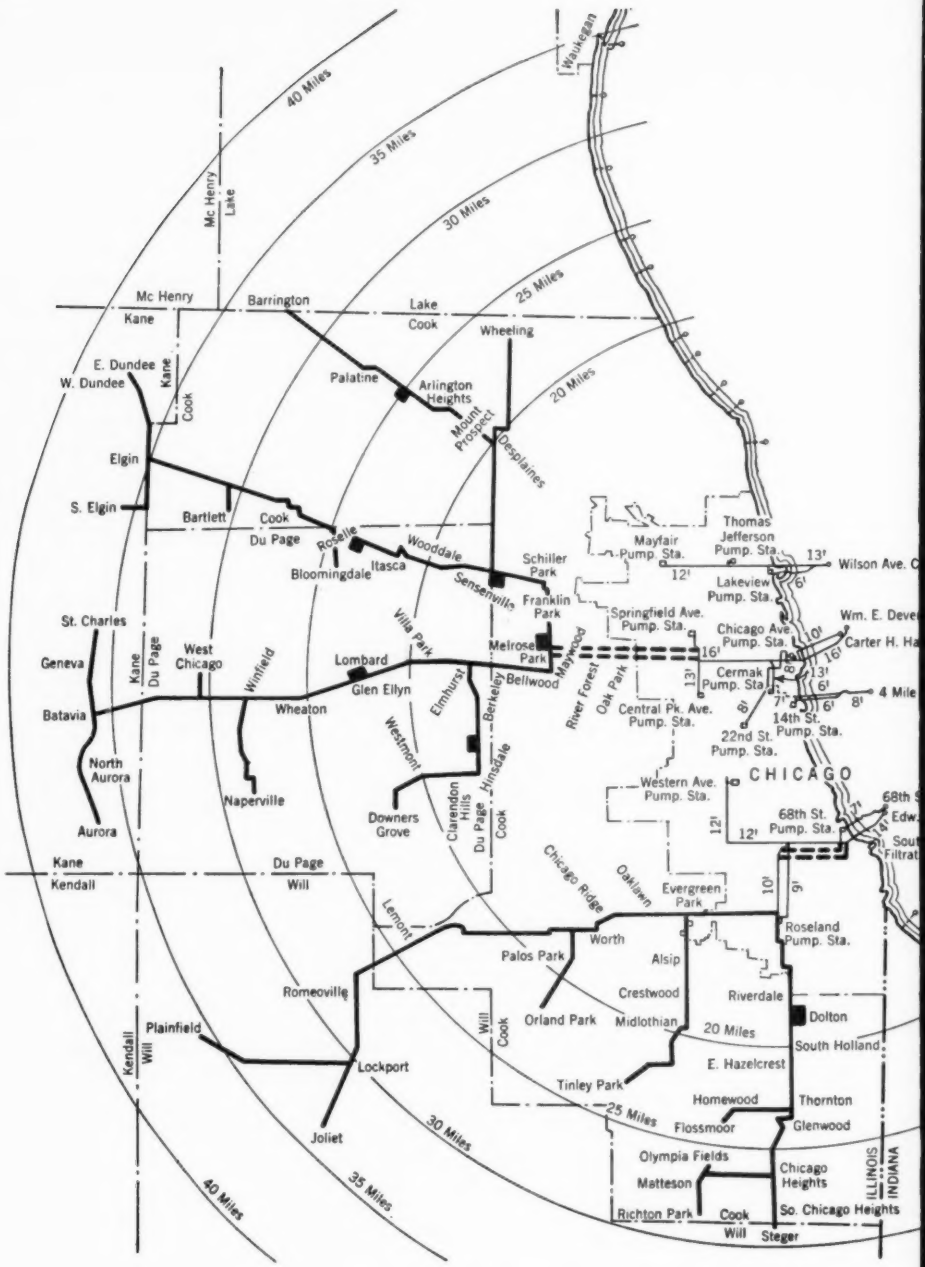
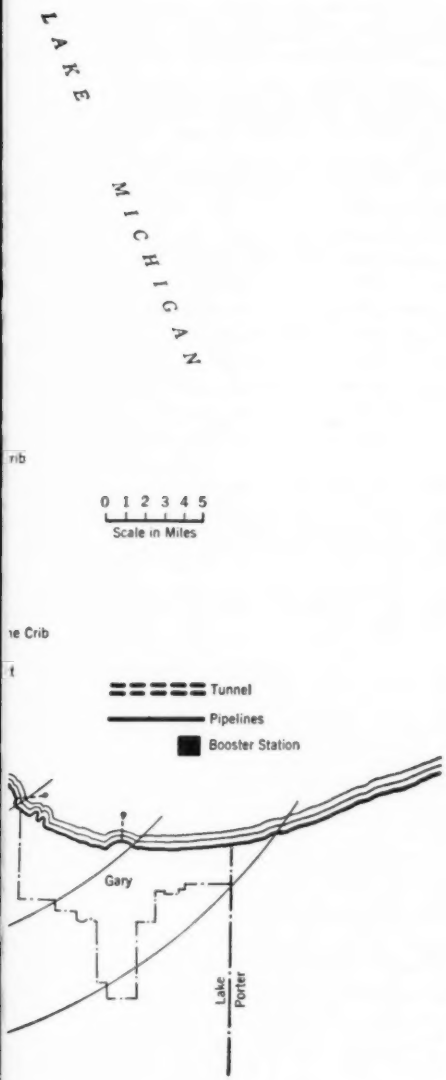


FIG. 1. A Water Supply System for the Chicago Metro



n Area

diana industrial area are a few small residential communities, and beyond these, farming country.

Attention should also be called to the city of Joliet, Ill., lying to the southwest of Chicago, approximately 35 miles from the intersection of State and Madison Streets. Joliet is an industrial city with a number of large and important plants and is strategically located on the Desplaines River at what is sometimes called the head of the Illinois waterway. It is also an important railroad center.

Elgin and Aurora are two other fairly good-sized cities west of Chicago and approximately 35 miles from the Loop. Each is a center of a rich farming area and, no doubt, will continue to be purely residential and commercial.

Population

The 1940 U.S. census gave the 168 incorporated communities in the Chicago metropolitan area a population of 4,617,990. Although the census gave no figures for the 25 unincorporated villages, the rural and unincorporated population is estimated at 191,260, making a total of 4,799,250 for the entire metropolitan area. Chicago, with 3,396,808 inhabitants in 1940, represented 71 per cent of the population of the metropolitan area; approximately 90 per cent of the population of the area was within a radius of 25 miles from the intersection of State and Madison Streets.

Lake Michigan Supply

From Waukegan on the north to Gary on the south, and including these cities, there are 15 municipalities (with a population of 3,816,234 as of 1940) obtaining water through their own intakes from Lake Michigan. In ad-

dition, Chicago supplies Lake Michigan water either directly or indirectly to 45 towns having a population in 1940 of 398,215. Therefore, a total of 60 towns, or 35 per cent of the municipalities within the 40-mile circle use Lake Michigan water. These 60 towns have a population of 4,214,440. Assuming the combined population of the 168 incorporated municipalities within the 40-mile circle to be 4,607,991, approximately 91 per cent of the incorporated population within the 40-mile circle secures a water supply from Lake Michigan at the present time.

Ground Water Supplies

With the exception of the municipalities taking their water supply from Lake Michigan, all others in the Chicago metropolitan area secure their water from wells of varying depths. In the Chicago area, the majority of these wells extend either into the St. Peter or Potsdam Sandstones and range in depth from 500 to 2,300 ft.

The demand for water from these wells has been growing for many years, and the elevation of the water table has been dropping at an average annual rate of 5–8 ft. Because of this rapid lowering of the water level, the cost of pumping water from these wells has greatly increased. Also, many municipalities have been compelled to drill wells to such a great depth that the mineral content of the water is highly unsatisfactory and usually extremely hard. So many new wells have been driven in recent years and the demand has been so great that the majority of the municipalities in the area find their water supply absolutely inadequate to serve their purposes now or in the future.

As far back as 1931, Winfred D. Gerber, an Illinois State Water Survey engineer, wrote (*2*):

> In the northern zone the increasingly heavy draft upon the rock wells is steadily lowering the pumping levels, thus adding a gradually increasing burden of pumping costs. This recession . . . has already reached such serious proportions in the metropolitan area of Chicago that . . . supplying filtered lake water to the municipalities and industries within a radius of 20 or more miles of the lake shore is being seriously proposed by well informed engineers.
>
> In former years the yield from the St. Peter sandstone was sufficient for all demands in such cities as Rockford, but so many wells have been drilled into the formation that in many places it is now practically dry. A recently drilled well near Barrington produced less than 20 gpm., while a new well at Crystal Lake gave practically no water from the sandstone.
>
> Specifications calling for wells that will produce 1,000 to 1,500 gpm. are being prepared at frequent intervals, and wells to deliver this great volume of water must penetrate as deeply as is possible, passing through all aquifers without entering areas of bad water. Even though such wells yield a high quality of fresh water during their early life, there is grave danger that with the lowering of the water level in the general vicinity of the well the hydraulic equilibrium will be unbalanced and water of inferior quality will be forced into the well from lowering depths.
>
> Not only are the water levels in wells in both the northern and central zones receding, causing the construction of new and larger wells, but analytical data indicate that the heavy pumping drafts are bringing about a detrimental change in water quality. Particularly is this true in the central zone, where water is obtained from drift wells.

A 1941 bulletin (*3*) of the Illinois State Water Survey Div. states:

Early records of water levels in the deep sandstone wells at the Washington Street Pumping Station in Joliet indicate that the water level when the wells were not being pumped was 40 ft. below the ground surface. When the new well, now known as Well No. 1, was drilled in 1937, [the] nonpumping water level was reported at a depth of 270 ft. This represents a recession of 230 ft. in 37 years or an average rate of 6.2 ft. per year. Apparently the larger part of this recession occurred during the latter 25 years, a period in which the water demands increased rapidly.

At Morris, Ill., the first well was drilled into the St. Peter sandstone in 1894. When completed the water level was above the ground surface. A second well into the same aquifer was drilled in 1902 and a third in 1915. In 1927 the water level in Well No. 3, when it was not being pumped, was 133 ft. below the ground surface, representing a recession of 133 ft. in 33 years, an average rate of 4 ft. per year.

Water levels have steadily receded in all the deep sandstone wells, not only in the Joliet-Morris-Wilmington area, but in the metropolitan area of Chicago and at other heavily pumped areas throughout the state. The recession of water levels represents a definite increase in pumping and maintenance costs.

At present the demand for large quantities of water by municipalities and industries in the Chicago area is aggravating the conditions outlined above, and there is every indication that those now depending upon ground water must soon make plans to secure their supplies from Lake Michigan.

Proposed Lake Michigan Supply

In August 1947 Commissioner Hewitt made public a plan (Fig. 1) for a possible extension of the Chicago water supply system to furnish Lake Michigan water to 62 municipalities in the metropolitan area now depending on ground water supplies. This plan was the result of studies made by the Bureau of Engineering over a period of years.

The municipalities to be served include Barrington on the northern boundary of Cook County, Elgin, St. Charles and Aurora on the west and Joliet on the southwest, and extend to the south line of Cook County. This system will serve Lake Michigan water to every municipality, in the area under consideration, not now supplied with water from Lake Michigan.

The 1940 census gave these 62 municipalities a population of 320,548, and it is estimated that their 1970 population will be 493,000. Based on a per capita consumption of 150 gpd., it is believed that the maximum-day demand in 1970 will be approximately 74 mil.gal.

The system is designed to meet the maximum day's demand in 1970 and to deliver water at ground level to the boundary of each municipality. Each town is to provide and maintain any necessary reservoirs and pumping equipment and distribute the water to the ultimate consumer. The water is to be metered at the point of delivery to each municipality.

The system has been divided into three major zones, the northwest, the west or central and the south. The required quantity of water for both the northwest and central zones will be available from the Chicago Avenue tunnel. A 10-ft. diameter extension of the Chicago Avenue tunnel to 25th Avenue, in Melrose Park, is proposed. Provision for a reservoir and low-lift pumps at the end of the tunnel has been made, so that if the peak demand by city consumers should require all the water in the tunnel for several hours, the suburban system could continue to pump from the reservoir,

which would be refilled during the off-peak period.

The northwest zone, taking water from the Chicago Avenue tunnel, will serve 19 communities, with an estimated population in 1970 of 111,600, and an estimated maximum-day demand of 16,740,000 gal. The northwest zone will require three booster pumping stations.

The central zone, taking water from the Chicago Avenue tunnel, will serve 18 communities, with an estimated population in 1970 of 224,600, and an estimated maximum-day demand of 33,690,000 gal. This zone will require two booster pumping stations.

The south zone, taking water from the Roseland Pumping Station, will serve 25 communities, with an estimated population in 1970 of 156,800, and an estimated maximum-day demand of 23,415,000 gal. The south zone is divided into two projects, both getting water from the Roseland Pumping Station. To increase the capacity of the Roseland station, a new, 12-ft. tunnel is to be built in 74th Street, from Oglesby Avenue to State Street. This will take its water supply from the existing tunnel at Oglesby Avenue and connect with the 10-ft. tunnel running south in State Street to the Roseland Pumping Station.

The Chicago Heights project will require a reservoir and a booster station near 151st Street and Indiana Avenue. If the peak city demand should use all the water available from the main, the booster could continue to pump from the reservoir, which would be refilled during the off-peak period.

The Joliet project will be exclusively supplied by new pumps at the Roseland Pumping Station, which will deliver the water at sufficient pressure so that no booster station will be needed.

Preliminary cost estimates, made from the drawings, indicate that the metropolitan water supply system outlined could deliver Lake Michigan water to the municipalities under consideration at reasonable rates. New legislation would be required to enable Chicago to extend its water supply system beyond the city limits.

Acknowledgment

The author is indebted to H. E. Hudson Jr. and Max Suter, of the Illinois State Water Survey Div., for data concerning the ground water situation in the Chicago metropolitan area.

References

1. Buswell, A. M. Development of the Water Resources of Illinois. Illinois State Water Survey Div. Rept., Urbana, Ill. (Jan. 3, 1948).
2. Gerber, W. D. Hydrology of Industrial and Municipal Water Supplies in Illinois. Circular No. 11, Illinois State Water Survey Div. (1931).
3. Illinois State Water Survey Div. Bul. 34 (1941).

Regulation of Water Use in Air Conditioning

Committee Report

A committee report presented on May 31, 1949, at the Annual Conference, Chicago, by Frank C. Amsbary, Jr., Chairman, Committee A1.C—Water Use in Air Conditioning. The other members of the committee are: Elwood L. Bean, Ted H. Kain, Logan L. Lewis and Marsden C. Smith.

THIS committee was appointed to investigate the problem created by the use of water from public supplies for air conditioning, and to suggest regulations by which the conservation of such water might best be secured. In the beginning the task seemed to be relatively simple; but as the work of the committee has progressed, difficulties have been encountered which cause the committee to be woefully unprepared to submit its report at this time.

This unpreparedness is not due to neglect nor to procrastination by the committee, but to the serious complexity of the legal, technical, political and other controlling factors too numerous to warrant listing here. For example, strange as it may seem, even the quality of the water supplied has its effect on the problem of water use in air-conditioning equipment.

Many and complete statistics have previously been published which forcibly prove the seriousness of the demand for water by air-conditioning machines. If these data are confirmed in the future, rare and fortunate will be the water system which is able to supply this demand without serious strain on every part of its system from the source to the service pipes.

The notorious coincidence of the peak of air-conditioning demand with the usual hot-weather peak for most other purposes further intensifies the problem and the cost of water supply.

The public desire for hot-weather comfort and the force of the commercial interest of those who would benefit from air conditioning will build up a terrific pressure against any rule that seriously interferes with its availability. Surely a regulation affecting air conditioning must be able to stand the closest legal scrutiny and the most aggressive opposition. Rates to cover adequately the true relative cost of water supplied for air conditioning will be hard to establish and their approval much harder to secure.

The committee has obtained the cooperative attention of the manufacturers of air conditioning equipment. It is now believed that if pressure is intelligently applied, the industry can do much to reduce the seriousness of the water demand. But certainly the industry cannot be expected to accept placidly an unreasonable action by the water or sewer utilities or to spend money for the more efficient use of water unless it is led to realize the necessity for doing so. The committee believes that it is the best agency to secure industry's cooperation.

There is a great probability that *demand* may become the most practical

and approved method of fairly and impartially determining the true cost of supplying water for air conditioning. By "demand" is meant the maximum rate of use of water within an established number of consecutive minutes or hours. The committee feels that it is the best agency to determine the practicability of measuring water demand.

The support by any state or national water resources agency of any regulation recommended by the A.W.W.A. would materially strengthen such a rule or regulation. The committee believes that this support should be sought and that the committee is the best agency to do so.

Only a few water and sewage utilities and the Virginia Section of the A.W.W.A. have taken formal notice of the problem. Hence, there is virtually no precedent established upon which a sound recommendation can be founded. And public opinion has forced one municipally owned system to modify seriously one of the extremely few regulations that actually interfered with the unlimited use of water for air conditioning. The committee feels that it should formally approach the various regulatory commissions as well as the legal advisors of as many water systems as may be necessary to obtain a better guide for the committee's recommendations than is now available.

The committee, therefore, requests that it be continued in organization so that it may have the opportunity to accomplish these and other objectives through which it hopes to devise a program of control and conservation of water that will be most likely of acceptance because it is the most rational and practical.

Meeting Increased Demand

The following statements represent the best considered opinion of the committee at present and are tentatively offered at this time for whatever value they may have.

It is believed that those in responsible charge of the water utility should make a thorough study of the probable future loads which may be created by air-conditioning and refrigerating demands. It has been found to be wiser, easier, and psychologically better, from the viewpoint of the water customer, to preclude troubles from this source through a carefully planned and comprehensive program of water conservation, rather than to wait until the problem has burst upon the community and then, during periods of shortage, attempt the conversion of existing equipment to reduce water consumption.

The demand is increasing as the result of developments which provide the homeowner and others with many new kinds of water-consuming devices. No one can deny any of these new owners the extra water which they require, assuming that no class of customer becomes an economic burden on the water plant, or jeopardizes public health and safety. It is the duty of each utility not only to safeguard the future but also to anticipate and to serve the growing needs of its community.

Various communities present radically different air-conditioning problems, depending upon the temperature at which the water is received by the consumer. If the temperature of the water is below 60°F., it may be used directly in the water coils of the air-conditioning apparatus as a substitute for refrigeration, thereby cutting the cost of air conditioning perhaps as

much as 50 per cent. If the temperature runs well above 60°F., refrigeration becomes an essential part of the air-conditioning installation.

In the first instance, the water demand is not irreducible, as air conditioning may be accomplished satfactorily with comparatively small amounts of water, although at a higher cost. No prohibition of air-conditioning equipment should be necessary. The only requirement is that demands for water should be reduced to a reasonable minimum.

In the second instance, in which refrigeration is used, conservation may be accomplished by evaporative condensers, cooling towers, spray ponds and similar types of water-conserving equipment, reducing the requirements for water to only that amount needed for makeup and flushout purposes. As much as 95 per cent of the water otherwise required for cooling the condensers of refrigerating machines may be saved by the addition of one of these water conservation devices.

The installation of water conservation equipment in conjunction with refrigeration will increase the original cost of the plant, and the consumption of energy used to operate the total installation is also increased. As the major use comes in the summer and during daylight hours, this will be an off-peak load for the power plant, if it does not overload the downtown network (the major peaks in power demand occur in the winter). This type of load should be welcomed by the power utility.

As stated above, water conservation equipment will increase the costs for power, but the increase is frequently completely offset by the saving resulting from the reduced cost of water service. There are locations where water rates are such that the saving in the cost of water service is sufficient not only to carry the added power costs, but in addition will offset the fixed charges on this additional investment. In other places this situation is reversed.

The amount of water used in air-conditioning equipment at peak-day loadings has been reported to range from a low of 22 per cent of a single day's total output to a high of 50 per cent in the Loop district in Chicago. To design a water plant, source of supply, treatment plant, storage, high-duty pumping and distribution system to handle this load for a maximum of 1,000 hours per year in the North and 1,600 in the South immediately presents a problem in economics. Since this peak of actual water use might be maintained for only 100 hours a year, or even less, the problem then becomes economically monstrous.

Need for Regulation

To collect sufficient revenue from all classes of metered customers to assure a fair return on plant investment, for the benefit of the few that are creating these demands through uncontrolled use of water in air conditioning would be discriminatory. To assign the true proportion of the plant investment required to serve uncontrolled air-conditioning water demands, and to set up a surcharge for such use so that the revenue so derived would result in a fair return on that portion of the physical plant investment, would result in a prohibitive rate, thus forcing the customer immediately to some type of water conservation equipment. Consequently, the question boils down to: [1] the establishment of a surcharge if

water conservation equipment is not used; [2] an appeal to the public spirit of the customer in the hope that he will cooperate by using water economizers; or [3] the establishment of regulations requiring water conservation equipment to be an integral part of all installations.

Taking each one of these "solutions" separately:

1. The establishment of a surcharge is in effect discrimination "at a price," and, as pointed out above, if properly set up on a sound economic basis would be so prohibitive that water economizers would be necessary.

2. When cooperation is asked, some will cooperate, but others will not, and, although the utility is in no way responsible—since it enforces no rules, regulations and conditions of service—discrimination actually exists.

3. Therefore, rules, regulations and conditions of service seem to be the real solution.

Obviously the problems of no two water utilities are the same and each requires individual analysis. The community depending for its source of supply upon wells from an aquifer that is not readily recharged naturally or artificially should institute conservation on a broad plane. With surface supplies, where the visible supply is adequate for the foreseeable future, either the treatment plant, storage, high-duty pumping equipment or distribution system facilities pose the basic problems. Here the question is purely economic and must be solved as best suits the conditions.

It must be realized that air conditioning has graduated from a luxury into a necessity in many lines of business. Its installation promotes the general welfare of the community, and encouraging its use is of interest to the utility, but it must be done without putting the water supply, current or future, in jeopardy.

Other Problems

Certain problems will now be considered which have not been solved by the committee.

Several of the basic questions which must be answered are:

1. Is the *local utility concerned with "comfort" air conditioning only?*

As a practical operational matter, it is exceedingly difficult to define "comfort" air conditioning, unless it is designated solely as that providing an environment which is comfortable to the majority of the people subjected thereto, whether in a theater, an industrial plant, a commercial establishment or any conditioned space. Such a definition would have to be based on the premise that "comfort" is a luxury. This proposition would be difficult, if not impossible, to sustain because "comfort" in a store or a theater is definitely good business. "Comfort" in an office or a factory enables the individual to do more and better work with less fatigue and, as claimed by many, with less damage to health.

2. *Is the utility concerned with other than comfort applications of refrigerating machinery, such as commercial refrigeration or refrigeration for various industrial uses?*

All refrigerating machines not equipped with water-conserving auxiliaries require much more water when it is warm than when it is cold. Machines which operate continuously in summer and winter have peak demands in critical hot-weather periods which are many times their demand at other periods, and although they

require much less water in winter, such machines are year-round consumers.

3. *Are there still other fields which are creating new demands and new uses for water, and, if so, will singling out one or both of the foregoing have the discriminatory effect of penalizing one type of user?*

If the community is growing and its demand and usage of water are increasing, conservation measures applied to only one of the fields responsible therefor will merely postpone the crisis instead of effecting a cure.

The committee does not recommend the installation of separate meters. It fails to see how anything is to be gained unless a surcharge is made for the water registered. This idea is considered expensive and often impractical.

The committee feels that every utility should do all it can to help in solving the problems of its customers. However, the utility should not assume responsibility for problems of the air-conditioning industry to any greater extent than for those of the power or other industries. For example, it is estimated that 0.30 gpm. of water per ton of refrigeration will be required as makeup if the water has a 250-ppm. hardness or more, while below 250 ppm. the requirements for water become progressively less as the hardness decreases, reaching a low of 0.10 gpm. or less. Many known installations have met low requirements in gallons per minute through the use of zeolite softeners for filling the system and for makeup water. Difficulties resulting from high alkalinities due to the concentration of salts may be overcome by periodic flushing of the system or by pH adjustment; sediment troubles may be controlled by providing proper sediment pans at the bottom of a tower; lowered pH may be corrected to prevent corrosion, and so forth.

The health angle must be kept in mind. Under no conditions should the water used in cooling condensers be returned to the utility's distribution system. Pipes supplying water for makeup in spray towers and the like should enter over the top of the pan.

All customers who wish to install air conditioning should be required to take out a permit in advance of installation and should give notice of completion. This procedure will provide an up-to-date record permitting the utility to ascertain at any time the actual intensity of the problem created by air conditioning and facilitating inspection. Whether rules and regulations to govern the use of water are contemplated or not, the record thus provided will serve many other useful purposes, such as the proper sizing of the service line and meter.

The committee would like to call attention to the fact that air-cooled refrigerating units may be used for small loads. It is believed that those in responsible charge of the water utility should urge the customer to investigate thoroughly the adaptability of this type of equipment and to make such an installation, if suitable.

Tentative Regulations

For all apparatus or equipment installed for the purpose of changing the dry-bulb temperature or humidity content of the air, whether used in conjunction with summer comfort air conditioning or other refrigeration, the following regulations are tentatively suggested:

1. All compressor type refrigeration units having a standard rated capacity* of 5 tons or less may be equipped with water-cooled condensers using water from the mains, provided that not more than one such unit with such capacity and so equipped—or a group of units with such a total capacity—may be used in one air-conditioning or refrigerating system, except for emergency standby purposes; and provided further that at no time shall the requirements for water exceed 10 gpm. if its temperature is 75° F. or lower, or 15 gpm. if above 75°. ("System" as used here shall refer to all apparatus or machinery required to air-condition, or refrigerate, the space or cubage under one proprietorship, whether owner of property or tenant.)

2. All compressor type refrigeration units having standard rated capacities* of 5 tons or over shall be equipped with evaporative condensers, evaporative coolers and condensers, cooling towers, spray ponds or other water-cooling equipment, so that all water from the mains is used for makeup purposes only, and shall be so adjusted that the average rate of makeup water under full loading will not exceed 0.10 gpm. per ton. (Such a standard can be met only when the hardness of the water supplied is 170 ppm. or less. If the utility wishes to assume some responsibility for the quality of the water, this limit may be raised to 0.1 gpm. for each 85 ppm. of hardness.)

3. If other than compressor types of refrigeration are used—such as [1] systems using water that is available at temperatures suitable for cooling use without refrigeration, such as washers or cooling coils; [2] dehydration systems, in which desiccants or salt solutions are used; or [3] systems using a heat-actuated mechanism—the consumption of water from the mains shall be limited in amount to not more per ton of refrigeration produced than would be used by the compressor type under Paragraph 1 or 2 above, as of the date of adoption of this regulation, when operated in accordance with the conditions given for a Group 4 rating by the American Society of Refrigerating Engrs.

4. *Penalty:*

a. $—— per day per horsepower of unit operated in violation, the penalty continuing until the violation shall cease, as verified by a daily inspection made by a representative of the utility. If the violation is continued with no assurance of cooperation, after a reasonable time, service should be discontinued; or

b. All water used in the particular billing period when the violation is found shall be billed at the basic rate, with discontinuance of service for repeated or successive violation.

c. Licensed plumbers guilty of having made such "illegal" installations shall be prohibited from securing further permits. If a repeated offender, charges shall be preferred to the proper authority for revocation of the license.

Conclusion

In suggesting an upper limit of 10–15 gpm., the committee realizes that this is an excessive quantity of water when one considers that it amounts to approximately 40 times the average use per customer and approximately 150 times the average residential use. The

* For purposes of simplification in administration, with a modern type of refrigeration equipment one compressor horsepower may be accepted as equivalent to one ton of refrigeration.

committee feels that, in the present stage of development of air-conditioning equipment, the regulations must be practical. When the space to be air-conditioned requires equipment that uses less than 10 gpm., the very nature of the premises is more frequently unfavorable for the installation of water conservation equipment than favorable. It is this factor that has dictated the 10–15-gpm. limit at present.

The committee also wishes to point out that there is no air-conditioning equipment so small that water economizers cannot be applied; and, when practical from the standpoint of suitable space for installation, economizers should be used regardless of the capacity of the conditioning unit. Limitations of space and suitability depend on the type of structure and are usually found in old buildings. New ones may be designed to accommodate proper water conservation equipment.

It is hoped and believed that a year's time will permit the crystallization of this committee's present tentative ideas. The committee therefore requests written comment by any one interested in water conservation. Conservation is the general problem, of which air conditioning is merely a part.

APPENDIX

Air-Conditioning Regulations

Below are quoted excerpts from the air-conditioning regulations in force in various localities in the United States.

Phoenix, Ariz.

[NOTE: *The following statement on air conditioning in Phoenix, Ariz., was made on November 24, 1948, by James Girand, Supt., Phoenix Water Dept.*]

We believe Phoenix has more air conditioning than any other city in the United States.

The evaporative type of air-conditioning unit is highly successful due to the dry climate. An ordinary evaporative unit uses less than 0.1 gpm. of water and will not actuate a water meter if no other outlets are open. Our checks indicate that every house in Phoenix is equipped with at least one or more of these evaporative units, which adds a considerable load to our water system.

Refrigerated air conditioning is widely installed in the homes which can afford it. All of these services are metered and water is charged at the regular rate. Waste water from these units is discharged into the sanitary sewer system. We consider that the regular water rates yield us a margin of profit which justifies handling the discharge through the sewer system. These home units, ranging up to 5 and 10 tons, use from 5 to 10 gpm. of water.

Air conditioning for the downtown buildings is generally handled by deep wells drilled on the site. The temperature of this water is satisfactory for a large refrigeration unit. The warm waste water is usually discharged into our storm drain system and we make a charge of 00.42¢ per 1,000 gal. for this service. Originally the water was discharged into return wells, but it was not long until the temperature of the underground water table had risen to a point that the refrigeration machines were going out of service.

We cannot see that any restriction of water consumption is indicated, or, to put it another way, we feel we are in the business of selling water—not saving it—and we welcome these new loads which enable us to sell a larger quantity of water, thereby increasing our profits.

Sacramento, Calif.*

It shall be unlawful for any single establishment to discharge into the sewers of the City of Sacramento, either directly

* Ordinance No. 762—Fourth Series—First Section.

or indirectly, waste water from a cooling system at a rate in excess of 1 gpm. per foot of frontage.

Champaign-Urbana, Ill.

In all apparatus or equipment installed for the purpose of changing the dry-bulb temperature or humidity content of the air, whether used in conjunction with summer comfort air conditioning or other refrigeration, the following regulations shall apply:

(a) The use of water is prohibited when used directly from the mains as a cooling medium in air washers or any type of equipment whereby the air to be conditioned comes into direct contact with sprays or wet surfaces, or where the water is used as the direct or indirect cooling medium in coils.

(b) The use of water is prohibited in all compressor type refrigeration units having standard rated capacities * of 1½ tons or less.

(c) All compressor type refrigeration units having standard rated capacities * of from 1½ to 5 tons may be equipped with water-cooled condensers using water from the mains; provided that not more than one such unit with such capacity and so equipped may be used in an air-conditioning or refrigerating system, except for emergency standby purposes.

(d) All compressor type refrigeration units having standard rated capacities * of 5 tons or over shall be equipped with evaporative condensers, evaporative coolers and condensers, water-cooling towers, spray ponds or other water-cooling equipment, so that all water from the mains is used for makeup purposes only.

(e) If other than compressor types of refrigeration units are used, the consumption of water from the mains shall be limited in amount to not more per ton of refrigeration produced than would be used by the compressor type described under (c) or (d) above when such type is operated under normal conditions.

Failure to comply with the above regulations shall be sufficient cause to discontinue service.

Elmira, N.Y.†

Sec. 48.1. *Purpose.* The purpose of this ordinance is to prevent the overloading of the City's sewers by the discharge therein of water used for cooling purposes.

Sec. 48.2. *Definitions.* For the purpose and within the meaning of this ordinance, the following definitions shall obtain:

(a) "Air conditioning" shall mean the cooling or dehumidification, or both, of space for human occupancy.

(b) "Refrigeration" shall mean the preservation of food products, process work and maintenance of storage temperature.

(c) "Direct water-cooling" shall mean the use of water as a refrigerant.

(d) "Indirect water-cooling" shall mean the use of water to extract heat from a refrigerant in a water-cooled condensing unit.

Sec. 48.3. *Direct water-cooling.* No air-conditioning equipment using water as a direct cooling medium may be installed unless a means of water disposal, other than discharge into the City's sewers, is provided.

Sec. 48.4. *Indirect water-cooling.* No air-conditioning or refrigeration equipment using water as an indirect cooling medium may be installed of more than 5-hp. total connected load per water meter connection unless [1] evaporative condensers, cooling tower, spray pond or some similar device with no sewer connection (except for seasonal cleaning and flushing) is used, or, [2] a means of water disposal other than the discharge into the City's sewers is provided.

Sec. 48.5. *Permits.* No air-conditioning equipment, and no refrigeration equipment of more than 5-hp. total connected load, shall be installed without first obtaining approval of the equipment, and

* Capacities shall be in accordance with conditions given in Standard A.S.R.E. [American Society of Refrigerating Engrs.] Testing and Rating Codes.

† Chapter IV, Art. VIII, Elmira City Ordinances.

permits from both the Superintendent of Building Construction and the Plumbing Inspector, before the installation is started.

Sec. 48.6. *Penalties.* Any person, firm, corporation or other, violating any provision of this ordinance, shall be deemed guilty of a misdemeanor and upon conviction thereof shall be subject to a fine of not exceeding $50.00, or to imprisonment for not exceeding 50 days, or to both such fine and imprisonment, for each and every violation and for each day and every day that such violation continues.

New York, N.Y.

[NOTE: *The following sections relating to refrigerative uses of water are taken from various rules and regulations of the New York City Dept. of Water Supply, Gas and Electricity, and may be found in the department's booklet, "Water Supply Facts, Rules and Regulations." The page numbers in brackets in the footnotes below refer to the 1948 edition of this booklet.*]

Prevention of Contamination

* Rule 9. *Condensers.* Direct water connection to refrigeration unit for cooling purposes shall be equipped with an approved check valve to prevent possible backflow of ammonia or other refrigerant from defective condenser coils or jackets, except in such installations where the water supply piping is entirely outside of the piping or tank containing the refrigerant and two independent wall thicknesses of metal separate the refrigerant from the city water supply. Refrigeration units containing more than 20 lb. of refrigerant shall be provided with an additional safeguard in the form of an approved relief valve installed at the outlet side of the check valve, such relief valve being set at 5 lb. above the maximum water pressure at the point of installation. Direct water connection is prohibited under Section C26–1223.0 Administrative Building Code.

† Sec. 170 (a). No person shall in the City of New York add, or engage in or by a sign or otherwise advertise or hold himself out as engaged in the business of adding, any chemical or other substance to the water supply within a building without a permit therefor from the Commissioner of Health. . . . The provisions of this section shall not apply to the treatment of water for industrial purposes, for swimming pools, for air-conditioning systems or for any use which does not include human consumption, but in all such cases proper precaution shall be taken to preclude the possibility that the treated water may come into contact with or contaminate the potable water supply distribution system of the building, and provisions satisfactory to the Dept. of Water Supply, Gas and Electricity shall be made to preclude the possibility that the treated water may come into contact with or contaminate the public water supply.

Rates and Charges ‡

Sec. 2–32. *Gas refrigeration.* The annual charge for water available for use or used for the purpose of cooling gas or gases to produce refrigeration shall be as follows: domestic use—not in excess of 75 lb. daily refrigeration, $3.75; not in excess of 100 lb. daily refrigeration, $5.25; business use—single units not in excess of 100 lb. daily refrigeration, $7.50; double units not in excess of 200 lb. daily refrigeration, $15.00.

Sec. 2–35. *Ice machines.* For any machine or apparatus used in the production of ice or refrigeration (or any air-conditioning machine or apparatus), a yearly charge of $30 per ton shall be made for the actual capacity of the machine or apparatus. The yearly charge for an ice machine or similar apparatus equipped with an approved water-conserving device shall be $4.50 per ton for

* Board of Standards and Appeals Rules Relative to Submerged Inlets and Protective Methods to be Applied to Prevent Contamination of Water Supply [p. 26].

† Regulations Governing Use of Well Water for Bathing, Flushing, Cooling or Domestic Purposes [p. 30].

‡ Rules and Regulations Fixing Uniform Annual Charges [p. 35].

the actual capacity of the machine or apparatus.

Air-conditioning units requiring a minimum rate of flow of water in excess of ½ gpm. shall be metered.

Air-conditioning equipment with a refrigeration unit which has a definite rate of capacity in tons or fraction thereof: the charge will be at the rate of $30 per annum per ton capacity from the date installed to the date when the supply is metered. Such units, when equipped with an approved water-conserving device, shall be charged at the rate of $4.50 per annum per ton capacity from the date installed to the date when the supply is metered.

Air-conditioning apparatus not equipped with a refrigerating unit or using water for other than refrigerating uses, for the cleaning or conditioning of air: the following rates are established for the period between the time the unit is installed and the date when the supply is metered: air-conditioning units requiring less than ½ gpm. of water, $6.00 per annum; air-conditioning units requiring ½ gpm. and up to, but not including, 1 gpm., $7.50 per annum; air-conditioning units requiring 1 gpm. and up to, but not including, 1½ gpm., $15.00 per annum; air-conditioning units requiring 1½ gpm. and up to, but not including, 2 gpm., $22.50 per annum; air-conditioning units requiring 2 gpm. and up to, but not including, 3 gpm., $30.00 per annum; air-conditioning units requiring 3 gpm. or more, $15.00 per gallon or fraction thereof, per annum.

Sec. 2–55. Charge for unmetered water used in the operation of any machine or apparatus not heretofore provided shall be on the basis of 15¢ per 100 cu.ft. of water consumed.

Sec. 3. *Meter rates.* The charge for water measured by meter shall be 15¢ per 100 cu.ft.

Permits *

121. *Unmetered water.* No unmetered city water shall be used in any premises where the supply is recorded as fully metered or in that part of any premises that is recorded as being supplied through a meter or meters.

145. *Refrigeration and air conditioning.* No new installation of refrigeration or air-conditioning equipment requiring the use of water shall be installed on any premises supplied from the municipal system until a permit authorizing such installation has been issued by the department. Applications for permits shall specify the make, type and tonnage of installation, the minimum and maximum water requirements and such additional information regarding the proposed installation as may be required by the department.

Where the maximum rate of water required for the operation of the apparatus exceeds ½ gpm., the supply shall be metered, subject to the discretion of the department. Where the minimum rate does not exceed ½ gpm. of water, the supply shall be metered or charged for on an annual rate basis subject to the discretion of the department.

Restrictions on Use *

146. *Air conditioning.* No individual or collective air-conditioning system installed on any premises for a single consumer shall be permitted to waste annually more than the equivalent of a continuous flow of 5 gpm. of city water. All individual or collective air-conditioning systems installed on any premises for a single consumer using city water annually in excess of the equivalent of 5 gpm. shall be equipped with a water-conserving device such as economizer, evaporative condenser, water cooling tower or other similar apparatus, which device shall not consume for makeup purposes in excess of 15 per cent of the consumption that would normally be used without such device.

Any individual or collective group of such units installed on any premises for a single consumer with a rated capacity of 25 tons or more, or water consumption of 50 gpm. or more, shall be equipped, where required by the department, with a

* Rules and Regulations Governing and Restricting Use and Supply of Water in New York City [p. 44].

water meter to separately register the consumption of such unit or group of units.

This rule shall also apply to all air-conditioning equipment now in service.

148. The use of the pressure or flow of water from the city system as a source of energy is prohibited except when specifically approved by the department. The use of water is permitted subject to such conditions or reservations as the department may consider reasonable. The department reserves the right to restrict or prohibit extraordinary use of water if water supply conditions so require.

The City is not required to maintain any minimum pressure other than that required to deliver water into the basement of any premises.

Violations and Penalties *

220. In case of violation of any of the preceding rules and regulations, or any of the laws or statutes relating to water supply, or if it shall be found that a meter has been tampered with, the water supply will be shut off unless such additional charges as the Commissioner may impose are paid promptly, nor will the supply be reestablished except upon correction of the violation in conformity with department rules and upon payment of the expense of shutting off and turning on the water supply. Satisfactory assurance shall also be made that no future cause for complaint will be given.

221. Licensed plumbers guilty of violating any of the rules and regulations herein shall be prohibited from securing further permits from this department and where willful violations warrant, the Commissioner may prefer charges to the Dept. of Health for the revocation of a Master Plumber's license.

Rochester, N.Y.†

14.1–1. *Permit required.* No person, firm, association or corporation shall install or use for air conditioning within the City, any equipment which uses water supplied by the City without having procured a permit therefor from the superintendent of water works.

An air-conditioning system for the purposes of this ordinance is hereby defined as any system using refrigeration to maintain air temperature of 60°F. or over, in an air-conditioned space.

14.1–2. *Application for permits.* Applications for permits for air-conditioning units heretofore or hereafter installed shall be made to the superintendent of water works and shall contain the name and address of the applicant, the location of the premises where the unit is or is to be installed, the name of the manufacturer of the unit, the manufacturer's maximum rating as to capacity of the unit in tons of refrigeration and the refrigeration temperatures involved in these ratings and the horsepower required under maximum anticipated summer operating conditions. In no case shall the rated capacity of the refrigeration unit in tons be considered less than the nameplate horsepower of the driving equipment for the purposes of this ordinance. In the absence of the required manufacturer's maximum rating as to capacity of the unit in tons of refrigeration, for the purpose of this ordinance, the superintendent of water may specify the tonnage of the refrigeration unit by using the nameplate horsepower of the driving unit. The manufacturer's identifying classification and data on the refrigeration unit shall also be included on the application.

In case water conservation devices are required to comply with 14.1–6, subdivision (a), the name of the manufacturer and the guarantees on the water conservation device are to be given for maximum anticipated summer operating conditions, together with the manufacturer's identifying data on the equipment. In case the application is for the installation of a unit, approval must be obtained before installation of the equipment is started.

14.1–3. *Fees for permits.* Fees shall be paid at the time the application is filed and shall be $5.00, plus $0.10 per ton of capacity as set forth in the application or in the manner prescribed in 14.1–2.

* Rules and Regulations Governing and Restricting Use and Supply of Water in New York City [p. 44].
† Volume II, Chap. 14.1, Rochester Municipal Code.

14.1–4. *Issuance of permits.* Upon receipt of the application for a permit, the superintendent of water works shall cause an inspection to be made and if the installation complies with the requirements contained in subdivision (a) of 14.1–6, the superintendent of water works shall issue a final permit for the installation and/or use of said air-conditioning system.

If any existing installation does not comply with the requirements contained in subdivision (a) of 14.1–6, but does comply with the provisions of subdivision (b) of said section, the superintendent of water works may issue a temporary permit for the use of said installation which said temporary permit shall be valid only until June 1, 1949, and shall be issued upon condition that the applicant take immediate steps to comply with the requirements of subdivision (a) of 14.1–6.

14.1–5. *Revocation of permits.* Any permit issued hereunder may be revoked summarily upon conviction for violation of this ordinance or upon failure of the holder of said permit to discontinue using water for air conditioning immediately upon orders of the superintendent of water works so to do.

14.1–6. *Requirements:*

(a) No final permit shall be issued for the installation and/or use of any air-conditioning units unless:

(1) Any such installation consisting of one unit, or a group of units, with a total capacity exceeding 5 tons or 50,000 Btu. per hour or requiring more than 5 hp. to drive the compressor shall be equipped with a condensing water conservation device. These water conservation devices shall be such that under maximum summer temperatures they can operate at not over 7.5 gph. of city water per hour per ton of refrigeration. Units of 5-ton capacity and under which do not have water conservation devices shall be provided with an automatic water-regulating device so as to limit the use of water under maximum summer conditions to not more than 2 gpm. per ton.

(2) Makeup water connections to a water conservation device are so arranged that the supply has a physical break between the city water main and said device so it will be impossible for water to siphon back in case of low pressure in the city water main.

(3) In cases where the waste water is discharged into the city sewerage system, the discharge is in strict accordance with the rules and regulations of the board of health of the City of Rochester and any other bureau having jurisdiction.

(4) The superintendent of water works is satisfied the system can be operated without adversely affecting the flow to other users of water in the area or detriment to public safety.

(5) The system complies with any restrictions imposed by laws of the State of New York or the New York State Dept. of Health.

(b) No temporary permit shall be issued for the use of any existing air-conditioning units unless the installation complies with the provisions of paragraphs (3), (4) and (5) hereinabove set forth for a final permit.

14.1–7. *Regulations:*

1. All air-conditioning installations shall be operated in accordance with the laws of the State of New York and ordinances of the Council of the City of Rochester.

2. No installation for which a temporary permit has been issued shall be operated at any time when the superintendent of water works shall have ordered the discontinuance of such operation.

14.1–8. *Penalties.* Any person violating any provisions of this ordinance shall be guilty of a misdemeanor and shall be liable to a fine of $150 or imprisonment not exceeding 150 days, or both such fine and imprisonment, or a penalty of $500 to be recovered by the City of Rochester in a civil action. Every day of such violation may be held to constitute a separate offense.

Philadelphia, Pa.*

1. *Permissible refrigerants.* For air-conditioning work, where a direct connection to the city water supply is made, the refrigerant must be nontoxic, noninflammable, nonirritant and noncorrosive.

2. *Connections to city water mains.* Any system or combination of systems requiring city water in excess of a total of 10 cfm. of water for refrigerant condensing purposes, maximum demand, must be provided with a water conservation device having a physical break with a city supply. A system, consisting of a single unit or multiple units, having a total capacity of not over 25 tons nominal capacity may have a direct connection to the city water supply for its source of condensing water, provided that the maximum use of water shall not exceed 10 cfm. and the amount of refrigerant shall not exceed 175 lb. The supply may be obtained from an existing ferrule, which must be metered.

In any case, however, where direct connections are made to the city water supply mains, a hand-operated gate and check valve, Crane or equal, must be provided in the connection between the city water supply and the refrigerating system. In addition, there must be installed a refrigerant pressure-operated water-regulating valve.

Makeup water connections to a water conservation device must be so arranged that the supply has a physical break between the city water main and said device, so it will be impossible for water to siphon back in case of low pressure in the city water main.

Where the waste water is discharged into the city sewerage system, it must be in strict accordance with the rules and regulations of the Board of Health and other bureaus having jurisdiction.

Any other restrictions that may be made by the state health authorities shall be considered as a part of this code, if and when required.

Plans must be submitted in triplicate for approval before any material is ordered or work started.

Richmond, Va.

1. *General.* Effective January 28, 1949, previous memorandums on the restrictions of the quantity of water used for air-conditioning units are rescinded.

2. *Design of water services.* Applicant shall state the quantity of water in gallons per minute required from the city for the proposed units. The quantity shall not be less than 2.5 gpm. per ton, or equivalent, of refrigeration for units without evaporative condensers, cooling towers or other water-saving systems, or less than 0.03 gpm. per ton, or equivalent, of refrigeration for units equipped with such systems. The calculated quantity of water shall be added to the quantity of water determined by the department's standard procedure for sizing water services and meters.

3. *Size limitations.* Applications for water for air-conditioning units requiring quantities in excess of 50 gpm. shall be approved by the Chief of the Gas and Water Div.

Kenosha, Wis.†

Restrictions and Safeguards. No person, firm or corporation shall connect, alter or enlarge any drain, service or house sewer to any public sewer without a permit so to do from the Inspection Dept.; nor shall any person, firm or corporation increase above the normal as of October 1, 1937, the discharge of waste through any existing drain, service or house sewer to any public sewer without such a permit, and no such permit or increased discharge shall be granted without the approval of the City Engineer, who, before approving the issuance of such a permit, must determine that such increased discharge will not overburden the public sewer, having in mind the possibility of others demanding a like increase of discharge.

* Air-conditioning installation requirements adopted by the Philadelphia Bureau of Water, December 12, 1938.

† Ordinance No. 12 (1937).

[NOTE: *H. T. Rudgal, Supt., Kenosha Water Dept., comments: "The ordinance is not specific as to water from air-conditioning and refrigeration systems, but whenever approval for such systems is requested, each case is analyzed separately and approval or disapproval is based on the sewer conditions which exist."*]

Washington Suburban Sanitary District*

WHEREAS, The increased use of water-cooled air-conditioning equipment, refrigeration machinery and compressors has involved the consumption of water in an amount not anticipated, and has put an entirely unlooked-for burden upon the sanitary sewerage system of the Commission,

AND WHEREAS, The Commission feels that in the interest of the public and of its water supply and sewerage systems, it must regulate the installation of water-cooled air-conditioning equipment, refrigeration machinery and compressors,

NOW, THEREFORE, BE IT RESOLVED, That, in compliance with Section 10 of Chapter 122, of the Acts of the General Assembly of Maryland of 1918, the following regulation, entitled "Water-cooled Air-Conditioning Equipment, Refrigeration Machinery and Compressor Installations," is hereby established and adopted, said regulation to become effective as of September 15, 1948.

1. All water-cooled air-conditioning equipment, refrigeration machinery and compressor installations using water from the public water supply or discharging water into the public sanitary sewerage system shall be subject to the Commission's inspection and approval. Such installations shall be free of any possibility of cross connections or back siphonage and the connection of the installations with water and with waste pipes shall be done by a registered plumber. A written permit will be required for each installation, for which a charge of $3.00 will be made, which charge will include the expense of regular inspection. Extra charges will be made for additional inspections required on account of condemnation of work, or for premature request for inspection.

2. Such installations will not be permitted to take water from the Commission's system at a rate greater than 0.08 gpm. per ton of refrigeration and if necessary to accomplish this purpose, an approved type of economizer or cooling tower shall be installed as the plumbing inspector shall require. A ton of refrigeration shall be defined as the amount of heat required to melt ice at the rate of 1 ton in 24 hours.

3. Water from any such installations, whether or not water is taken from the public water supply system, shall not be discharged into the Commission's sanitary sewerage system at a rate in excess of the foregoing.

4. All water-cooled air-conditioning equipment, refrigeration machinery and compressor installations using water from, or discharging water into, the Commission's system, whether or not installed prior to the adoption of this section, where required, shall be modified to bring them into conformance with the provisions of these regulations not later than May 1, 1949.

5. Properties in which water-cooled air-conditioning equipment, refrigeration machinery and compressor installations are made contrary to the provisions of this section and are not promptly modified as directed, or installations made prior to the adoption of the section and not modified by May 1, 1949, will be disconnected from the Commission's systems until the requirements of this section are complied with.

* Washington Suburban Sanitary Commission resolution, August 31, 1948.

Water Main Extension Policy

Committee Report

A progress report of the Committee on Water Main Extension Policy, presented on May 31, 1949, at the Annual Conference, Chicago, by L. S. Finch, Chairman. The other committee members submitting the report are E. F. Dandridge, M. P. Hatcher and C. M. Hoskinson.

HOW to finance water main extensions into new territory must be one of the oldest problems of the water utility for which a generally acceptable solution has not yet been found.

The current study of this problem was initiated pursuant to an assignment from the Committee on Water Works Administration to study the administrative "problems involved in the extension of water mains, both within and without the corporation limits, including a digest of enabling legislation." This assignment is so broad, and the variation in prevailing practice so great, that the committee has not been able to complete the study in the time at its disposal. Consequently, this statement is but a progress report.

The final report of the committee on completion of its assignment, it is hoped, may serve as a guide to water works executives in the establishment and administration of water main extension policies and practices.

In carrying out their assignment, the committee members, being widely separated geographically, have found it difficult to appraise the various phases of the problem and to reach conclusions quickly which will represent viewpoints acceptable to all members. The problem of reaching unanimity of opinion has been rendered still more difficult by the fact that part of the committee has the viewpoint of municipally owned utilities while the rest sees things from the position of private ownership. Nevertheless, all are striving to maintain objectivity, so that the results of the study will have as broad an application as possible.

Progress to date has been accomplished through a process of successive approximations. In the operation of this process, a series of questionnaires has been submitted to all committee members. From their replies, preliminary statements of conclusions have been prepared and incorporated into supplementary questionnaires. Through a series of such approximations of opinion, it generally has been possible for each committeeman to have his viewpoints incorporated in the findings of the committee. Eventually, if there should be hopeless disagreement, it will be necessary for the opinion of the majority to prevail.

In first approaching the problem, the committee concluded that, before it attempted to develop proper administrative procedures, it first should establish general principles that could serve as a foundation upon which to base the details of procedure. A statement of the general principles which should be observed, regardless of local circumstances or type of ownership, has

been agreed upon tentatively. The committee now is considering the details of procedure which should be followed in implementing these principles.

This progress report, along with a discussion of the principles and practices to be followed, will include references and excerpts from certain of the reports published in the JOURNAL during the past 25 years. These will serve to provide a background of information which will assist the water works administrator in analyzing main extension problems. The excerpts also are intended to lend weight to the conclusions of the committee.

Statements of procedure under study by the committee, but on which general agreement has not yet been attained, are presented in an Appendix. This material has been attached to the report in the hope of stimulating discussion and encouraging submission of suggestions to the committee by members of the water industry.

The tentative conclusions of the committee regarding principles to be observed may be summarized by stating that water main extension policies should be nondiscriminatory; and, whether the utility be publicly or privately owned, the policies should be based upon business principles which will insure that the extensions will be self-supporting. Definite provision should be made for customer participation when the anticipated revenue from an extension may not be sufficient to warrant the entire investment being made by the utility. It is recognized by the committee that main extension policies, to be administered effectively, must be implemented by comprehensive rules incorporating the general points upon which the utility and the parties desiring extensions must have an understanding. Such rules should be reviewed periodically, lest, through changing circumstances, they become inequitable or discriminatory. A discussion of several of the features which should be incorporated in such rules has been included in this report.

In the Appendix are presented methods of determining proper investment in free extensions, refunds of deposits and other problems on which the committee has not formulated opinions.

Historical

The first comprehensive discussion of the water main extension problem was presented at the 1910 New Orleans meeting of the Association by J. W. Ledoux (1), W. J. Spalding (2) and others. In 1923 C. M. Saville (3), Mgr. and Chief Engr., Hartford, Conn., Water Dept., presented a paper which went far to analyze the extension problem of that day. Many points raised by Saville then are applicable today. In 1924 D. A. Reed (4), Mgr., Water and Light Dept., Duluth, Minn., stressed the fact that the same general business methods should be followed in operating both municipally and privately owned utilities.

L. A. Jackson (5), Mgr., Municipal Water Works, Little Rock, Ark., wrote a valuable paper in 1937 which included a digest of the methods of financing then being followed by 50 water utilities in all parts of the country. This summary is of interest largely to show the many different ways of solving the water main extension problem that prevailed only twelve years ago. In 1941 Jackson (6) reported a second survey of water main extension policies in 28 cities. In analyzing the results of his survey, he stated: "It would seem that the prevailing practice is for the department to furnish a portion of the funds, the

consumer to pay the balance, and the department to make refunds to the consumer. The amount of money expended by the department is usually established by capitalizing the anticipated or guaranteed revenue on a gross per cent return basis. The majority of plants have a fixed requirement such as a percentage gross return that is considered by the management to warrant the expenditure."

Also in 1941 an article by F. R. Berry (7), then an engineer with the American Water Works & Electric Co., discussed many of the broad features involved in administering a water main extension policy. In addition, Berry presented a method of determining proper investment in main extensions which, with variations, has been included in the Appendix to this report as a basis for discussion. A. O. Norris (8), then Mgr., Birmingham, Ala., Water Co., in 1948 published a comprehensive discussion on the water main extension problem. Norris offered a method of determining proper utility investment in a main extension which was similar to the one presented by Berry in 1941 but which, through the use of illustrative statistics, was more clearly explained.

In 1947 D. D. Heffelfinger (9), Engr.-Supt., Alliance, Ohio, Water Dept., discussed several methods of financing extensions but presented illustrative figures regarding the proper "free extension" to be made by a utility which were based upon a method of computation similar to that of Berry and Norris.

Several worth-while papers and discussions regarding financing methods in California have been published in the JOURNAL and serve to show the diversity of practice in that state (10–12). A committee of the California Section, under the leadership of E. F. Dandridge, of Los Angeles, is now striving to develop a common method for handling main extension problems. (Dandridge is also a member of the present committee.)

The viewpoints of the Wisconsin Public Service Commission and of the Public Utilities Dept. of the California Railroad Commission on the main extension problem were presented in papers published in the Journal in 1942 (13) and 1944 (12), respectively.

The suburban aspects of the main extension problem have been touched upon in many of the references presented in this report, but a comprehensive paper dealing particularly with this question was presented in 1941 by M. B. Whitaker (14), Supt., Water Bureau, Knoxville, Tenn. In 1948 a valuable panel discussion (15) on "Service Extensions to Suburban Areas" took place at the Association's Annual Conference.

In 1947 W. V. Weir (16) presented a joint statement relative to water main extension policies which had been prepared by a panel of six men under his leadership. This statement to a large degree has served as the starting point in the current study. (It may be of interest to note that four of the six men serving on that panel are now members of this committee.)

Principles

The committee has agreed tentatively upon the following statement of principles to be observed in formulating and administering water main extension policies:

1. *Extension policies should be nondiscriminatory.*

It is axiomatic that extension policies should be nondiscriminatory, although different methods of application of the policies may be necessary in handling

problems related to distinct classes of new customers.

It is important that water main extension policies be nondiscriminatory, not only in the interest of equity, but also to prevent damage to customer relations and to insure the enforcibility of such rules as may be adopted in administering the policies. Courts have held (17) that rules relating to the financing of water main extensions, if discriminatory, are not valid and are unenforcible.

2. *Extension policies should be based upon business principles.*

Whether the utility is publicly or privately owned, water main extension policies should be based upon sound business principles applicable to utility rather than municipal operation.

3. *Extension policies should assure that main extensions will be self-supporting.*

Water main extensions should be self-supporting in that the revenue from them should be sufficient to meet the proper proportionate fixed charges related to the increment of the plant and property serving them, as well as to pay operating costs resulting from their addition to the system.

Precautions should be taken in implementing main extension policies to prevent the necessity of future rate increases to defray the cost of plant additions required by improperly financed main extensions.

In determining the amount of fixed charges to be placed against new extensions, the methods used should not result in discrimination against new consumers.

4. *Extension policies should provide for customer participation in the financing of extensions into localities within the utility service area where service is needed if the anticipated revenue is insufficient to warrant the utility making the extension unassisted.*

Water service is necessary to the welfare of a community. For that reason, it is desirable for water utilities to make their service available in the proper service areas. If the anticipated financial return is not sufficient to warrant the utility laying all of the water main required to provide the desired service, methods should be available through which prospective customers or promoters can finance or assist in financing the project.

5. *Extension policies should be implemented by the adoption and promulgation of comprehensive rules.*

To effect the extension of water mains upon a proper basis, after policies have been formulated, definite rules should be adopted. For privately owned utilities, it usually will be necessary that these rules be approved by the state commission regulating public utility operation. If the system is municipally owned, it may or may not be necessary for the water board, the municipal council or some other governmental agency to grant such approval. If approval should be required, it is important that the utility secure it since embarrassment likely will result from an attempt to enforce the rules without such official approval.

Extension rules should include comprehensive statements covering the principal points necessary to an understanding of the practice of the utility in providing for the extension of water mains.

6. *Extension rules should be reviewed periodically.*

Changing conditions may cause an extension rule to become inequitable or discriminatory. The terms of extension rules, particularly those pertaining to investment formulas, should

be reviewed periodically. Revisions should be made when definitely required to keep the extension rules fair to both old and new customers, as well as to the utility.

In considering the advisability of making changes in basic rules, however, it should be borne in mind that such revisions tend to damage public relations and, consequently, unless the need for a change is quite pronounced, it probably would be best not to make it.

Rules

In considering the rules which should be adopted for the purpose of implementing main extension policies, the committee has not attempted to frame the actual statements which should be included in the rules. It has agreed, however, upon the general content of several of the more important items which should be covered in such rules.

There follows a discussion of the bases for the more important of the rules which will be found necessary—insofar as the committee has been able to agree upon them.

Ownership of Extension

The ownership title to an extension should always be vested in the utility, regardless of promoters' advances or unrefunded contributions. The utility must undertake the maintenance and the ultimate replacement of the pipe and must have full control over the main, including the right to connect additional customers without the consent of the promoter.

Further Extensions

The utility should have the right to make additional extensions of a water main beyond or laterally from the initial extension. Further extensions should not be considered as additional connections to the extension and, therefore, should not be the basis for additional refunds to an extension promoter.

Pipe Sizes

The utility should determine the size and type of pipe to be used in each extension. If the utility wishes the pipe to be larger than that reasonably required to serve the territory traversed by the extension, the excess cost of the larger pipe should be borne by the utility. The cost of the proposed extension with relation to the revenue estimated to accrue from it should not be allowed to influence the utility in determining the size of pipe to be installed.

The size of the pipe selected normally should be sufficient to yield proper fire flows. Extensions of 2-, 3- or 4-in. pipe are proper when the relation of the extension to the distribution grid is such that neither the extension of fire protection to the area served nor the strengthening of the grid system is necessary. Such situations arise, for example, in a well grid-ironed system when domestic service is required on a short cross street, fire protection being afforded by larger mains on adjacent streets.

Utility Investment

The committee has agreed that the proper utility investment in a water main extension, when special assessments are not involved, should be based upon the amount of revenue to be derived from the extenson rather than upon the average width of the lot, the average number of feet of main per customer upon the existing distribution system, or other similar criteria.

The widely established practice of relating the utility investment in an extension to a stated number of feet of "free extension" has sometimes resulted in embarrassing situations as rising prices have continually decreased the free length of main which could be justified by the anticipated revenue from an extension. For that reason, the committee is considering the advisability of stating the utility investment in a free extension in terms of the number of dollars which the utility will invest for each dollar of revenue per anticipated customer upon the extension rather than the number of feet of free extension which will be installed per anticipated customer.

The credit to be allowed toward a "free extension" should be based upon a realistic estimate of the total revenue to be obtained from it. For residential and small commercial customers, it is usually possible to forecast the amount of the water bills within reasonable limits. In any event, it would appear to be more equitable to attempt to establish the credit by rational methods than to fix an arbitrary or zonal amount.

Actually, the crux of the water main extension problem lies in a determination of the amount—in dollars—that the utility can afford to contribute toward the cost of the extension. In studying this problem, the conclusions drawn in discussing Principle No. 3 (water main extensions should be self-supporting without being discriminatory against new customers) must be borne in mind and placed in practice.

In order to substantiate and enlarge upon this viewpoint, the following excerpts from papers by water works men familiar with the extension problem are presented:

The extension should pay [the] cost of supplying water, including fixed and operating charges on the original plant investment.

It is sometimes contended that, if there is plenty of water and the works, including supply lines, are adequate, all that is necessary is for the extension to pay operating costs, i.e., such costs as are a function of the amount of water used. This is discriminatory because it puts the burden on the other consumers of carrying fixed charges on the original plant and the extension draws a benefit without payment.

This method fails to take into consideration the fact that for every foot of extension of distribution system added to the plant there must sometime or other be a corresponding extension of the producing plant, the proportionate cost of which, under this method, the extension does not bear.—*C. M. Saville* (3).

Many managers lose sight of the fact that as their distribution system expands, their load and capacity demands increase and somewhere down the line there comes a day when a large capital expenditure is needed to bolster up the pumping plant, filter plant or primary distribution system. This type of betterment usually creates no new revenue. Those little extensions that were installed two, five and ten years ago are blood relatives of this new project and each in proportion is responsible and should bear the burden of part of the expense. It is plain to see that unless these future necessary expenditures that cannot be compensated by new revenue are considered in some degree, a further reduction is reflected in the net return.—*L. A. Jackson* (5).

The immediate investment will be the cost of the extension to the distribution system, a service line and probably a meter for each anticipated customer, and the cost of fire hydrants and fire hydrant branches, if fire service is to be furnished. These costs, however, are only part of the total; behind them are many items which are also essential—pumping stations, purification systems, transmission pipelines, distribution reservoirs, impounding reser-

voirs, dams, real estate, etc. It is obvious that a proper proportion of these and other items, referred to as supply facilities, must be considered as part of the capital investment necessary to render the service, or a water company will, at some time, inevitably be faced with the necessity of securing an increase in its rates or be unable to meet its financial obligations.

It has been argued that the investment in supply facilities has already been made and that no additional investment is necessary. This is a very short-sighted view and takes into consideration only the present and immediate future. A water company must, in fairness to its present customers, take a long-range view and recognize the fact that there will come a time when additional supply facilities must be added. Water works plants cannot be built in increments for one customer. If plants could be built in such a way, it would be necessary only to add to the cost of the distribution facilities the cost of the necessary supply increments to arrive at a total investment necessary to supply the new customers.—*F. R. Berry* (7).

Methods of computing the proper investment to be made by the utility in accordance with these principles will be outlined in detail in the Appendix as bases for discussion rather than as methods accepted by the committee.

Advance in Aid of Construction

Should the anticipated financial return from a proposed water main extension be insufficient to warrant the utility meeting the entire cost of the extension necessary to serve the area traversed, the promoter or prospective customers should be required to advance the additional cost involved in installing the main and its appurtenances. These payments should be considered a deposit to protect the utility against the loss which would be sustained if the use of the extension did not develop sufficiently to pay its share of all of the costs involved. Accordingly, the deposit should be subject to later refund as additional customers take service from the extension.

For industries or other users, when it is impossible to forecast the extent or permanence of their water demands, it would be reasonable to require the customer to meet the entire cost of the extension but to allow a refund based upon a percentage of revenues obtained.

Special methods of dealing with extensions for serving suburban areas or subdivisions are followed by many utilities. It is recognized that such areas do present problems, but it has been felt desirable that the more fundamental features of the basic problem be studied before consideration is given to the suburban or subdivision situation.

It should be noted that there has been no discussion of the part that assessments might play in meeting the cost of a main extension. This phase of the problem has been left for future consideration by the committee, after a study of the more common methods of financing has been completed.

Refund of Advance

Refunds for additional customers should be based upon a stated number of dollars for each dollar of accrued revenue received, or upon an estimated amount which will approximate the same result. The total amount of the refunds should not exceed the amount paid to the utility for the new extension.

Refunds made for additional customers connecting to a new extension should be limited to a stated period, preferably not exceeding ten years after the installation of the main. The utility ultimately must replace the pipe

installed. If the utility has not received sufficient revenue in a ten-year period to warrant assuming the full investment in that time, no additional investment should be made. It is doubtful whether such a low-revenue extension would allow the utility to accumulate enough money for replacement reserve to prevent the new extension from becoming an economic burden.

Because the money advanced by an extension promoter is paid out for the expenses of installation, any unrefunded balances do not represent income-producing assets of the utility. No interest, therefore, should be paid on these balances.

Money remaining in the hands of the utility at the end of the refund period should become the property of the utility and it should definitely be so stated in the rules, lest the question of ownership or further obligation of the utility arise.

A discussion of methods of computing refunds is presented in the Appendix, since the committee is not yet in agreement on this phase of the problem.

Summary

The committee appointed to study main extension problems has concluded that, before proper details of procedure in administering extension programs can be developed, it is necessary to agree on the broad considerations involved. Material upon which agreement has been reached is incorporated in this progress report; other considerations upon which agreement has not been reached, or which have not been considered fully, are included in an Appendix.

Four general principles which should be observed in formulating and administering water main extensions have been agreed upon by the committee. Extension policies should:

1. Be nondiscriminatory
2. Be based upon business principles
3. Assure that main extensions will be self-supporting
4. Provide for customer participation in the financing of extensions into localities within the utility service area where service is needed, if the anticipated revenue is insufficient to warrant the utility making the extension unassisted
5. Be implemented by the adoption and promulgation of comprehensive rules which should be reviewed periodically.

The committee has agreed upon the general content of most of the more important provisions that should be incorporated in rules under which main extension programs are to be administered. The general requirements upon which agreement tentatively has been reached may be summarized as follows:

1. The ownership of the main extension should be vested in the utility.
2. The utility should have the right to make additional extensions from the initial extension without incurring an additional obligation to the extension promoter.
3. The utility should be the one to determine the size of pipe to be used in the extension. The size should be sufficient to provide fire flow except in special situations. The extension project should be charged only with a pipe of sufficient size to afford proper service in the area traversed by the extension.
4. When special assessments are not involved, the utility investment in an extension should be based upon the amount of revenue to be derived from it.

5. If the utility investment is not sufficient to pay for the entire extension, the promoter of the extension should be required to deposit with the utility an advance in aid of construction sufficient to pay for the portion which will not be paid for by the utility.

6. This advance in aid of construction should be refunded to the promoter as additional customers take service from the extension. The amount of the refund should be based upon a stated number of dollars for each dollar of accrued revenue, or upon an estimated amount determined in advance of construction of the extension which will approximate the same result.

The committee definitely is anxious to receive suggestions and comments from members of the water works industry upon the content of the report, but more especially upon the material presented in the Appendix.

References

1. Ledoux, J. W. Water Rates and Extensions. Proc. A.W.W.A., p. 193 (1910).
2. Spalding, W. J. How to Provide for the Cost of Water Main Extensions. Proc. A.W.W.A., p. 199 (1910).
3. Saville, C. M. Financing Municipal Water Supply Extensions. Jour. A.W.W.A., **11**:38 (Jan. 1924).
4. Reed, D. A. Financing Water Main Installations. Jour. A.W.W.A., **15**: 258 (March 1926).
5. Jackson, L. A. Financing Water Main Extensions. Jour. A.W.W.A., **30**:1 (Jan. 1938).
6. ———. Survey of Water Main Extension Policies. Jour. A.W.W.A., **33**: 1357 (Aug. 1941).
7. Berry, F. R. Financial Considerations of Distribution System Extensions. Jour. A.W.W.A., **33**:1041 (June 1941).
8. Norris, A. O. Financing Distribution System Extensions. Jour. A.W.W.A., **41**:43 (Jan. 1949).
9. Heffelfinger, D. D. Financing Main Extensions. Jour. A.W.W.A., **39**:257 (March 1947).
10. Dandridge, E. F. Financing of Extensions in Los Angeles. Jour. A.W.W.A., **33**:219 (Feb. 1941).
11. Jones, M. S. Methods of Financnig Water Main Extensions in California. Jour. A.W.W.A., **34**:555 (April 1942).
12. McNaughton, E. F. Fundamentals of Utility Extension Rules. Jour. A.W.W.A., **36**:311 (March 1944).
13. Reynolds, P. A. Water Main Extension Policies in Wisconsin. Jour. A.W.W.A., **34**:544 (April 1942).
14. Whitaker, M. B. Problems and Limitations in the Installation of Water Main Extensions to Suburban Areas. Jour. A.W.W.A., **34**:561 (April 1942).
15. Anderson, S. T. et al. Service Extensions to Suburban Areas. Jour. A.W.W.A., **40**:1239 (Dec. 1948).
16. Weir, W. V. et al. Water Main Extension Policy. Jour. A.W.W.A., **39**: 1067 (Nov. 1947).
17. Parker, L. T. What to Do When Water Main Extensions Are Demanded. W.W. Eng., **102**:37 (Jan. 1949).

APPENDIX

Included in this Appendix is material falling into either or both of the following categories: [1] material presented in such detail that, were it included in the report, the continuity of thought desired in reviewing the problem as a whole would be lost; and [2] questions to which proper consideration has not been given or upon which substantial agreement has not been reached by the committee.

It should be definitely understood that the committee is neither endorsing nor advocating the adoption of methods or procedures discussed in this Appendix. The material is presented in the hope that it will stimulate discussion, since the committee is anxious to receive suggestions and comments regarding it from members of the water industry.

Determining Justified Investment

The committee is presenting for discussion two methods of determining the investment in a main extension which may be justified by the anticipated revenue.

Method A

Method *A* is based upon the philosophy that the portion of the revenue from a main extension which is to be used to support the construction of the free portion of the extension should bear the same relation to the total revenue from the extension that the portion of the utility revenues available to meet fixed charges related to local water mains and their appurtenances (including hydrants and hydrant branches) bears to the portion of the revenue from the entire utility ("net operating revenue") available to support the plant investment.

It has been proposed, although not agreed upon by all members of the committee, that the investment to be made by a utility in a water main extension be stated as "the number of dollars which the utility will invest for each dollar of revenue per anticipated customer upon an extension."

Under Method *A* of determining the proper utility investment, this ratio between revenue and the utility investment in a main extension may be expressed as a multiplier which can be determined in five steps from financial data available to most utilities, or which can be approximated rather closely by those not having all of the basic data. Once the multiplier is thus determined, the proper investment in free extension per customer can be obtained by multiplying the anticipated average revenue per extension customer by the same factor or multiplier. Inasmuch as, except under unusual conditions, the relation between revenue and the amount available to meet fixed charges will not vary widely from year to year, it should be possible to determine a multiplier which could serve without adjustment for several years.

The committee wishes to caution against the use of any of the results of the computations included in the following explanation of the proposed method, since these results are based upon assumed factors presented for illustrative purposes only.

Step 1: Determine the ratio of the utility "net operating revenue" to the "total operating revenues"; call this the "fixed-charge ratio."

It appears reasonable and in accordance with Principle No. 3 (*see* p. 732) that the anticipated revenue from an extension should be divided between expenses and the amount available to meet fixed charges, in the same ratio that the total operating revenues of the utility are thus divided. This "fixed-charge ratio" can be determined by dividing the annual net operating revenue by the annual total operating revenues.

If the amounts of these factors are not directly available, they can be found by entering the proper amounts in the blank spaces below and making the indicated computations. Spot determinations and averages based upon financial data covering several years of operation should be developed and compared before deciding upon the actual figures to use in completing these computations:

1. Compute annual total operating revenues by adding:

Revenue from water sales	$———	
Revenue from public fire protection service (hydrant rental, etc.)	$———	
Revenue from private fire protection service	$———	
Other operating revenue	$———	
Total operating revenues		$———

2. Compute operating expenses, depreciation and taxes by adding:

Total operating expenses	$———
Depreciation	$———
Taxes (federal, state, county and city, if any)	$———
Total deductions from operating revenues	−$———

3. Compute the net operating revenue (available to meet fixed charges) by subtracting Total No. 2 from Total No. 1:

Net operating revenue	$———

4. Compute the fixed-charge ratio by dividing the net operating revenue by the total operating revenues:

$$\frac{\text{Net operating revenue } (\$\text{———})}{\text{Total operating revenues } (\$\text{———})} \times 100 = \text{Fixed charge ratio } (\%)$$

If it is assumed that this ratio is 30 per cent and the average annual revenue from the system is $40 per customer, it will be seen that 30 per cent of $40, or $12.00 per customer, is available annually to meet fixed charges or to pay a return upon the total investment.

Step 2: Determine the investment which can be supported by the portion of the average revenue per customer allocated to fixed charges.

Assume the proper rate of return, the average interest rate on borrowed money, or other rate of capitalization deemed proper. (In this example, assume 6 per cent.) Then capitalize $12.00 (the amount per customer available to meet fixed charges, as determined in Step 1) at 6 per cent, and the result will be the investment which the average revenue per customer ($40) will support on the assumed basis. To make this determination, *divide* $12.00 by 6 per cent:

$$\$12 \div 6\% = \frac{\$12}{0.06} = \$200$$

Step 3: Determine the portion of the justified investment which can be allocated to payment of the cost of local mains and their appurtenances, including fire hydrants and hydrant branches.

It appears reasonable that the $200 investment which could be supported by a $40 customer should be divided between local mains and appurtenances, on the one hand (which may be likened to a water main extension within the purview of this study), and trunk and transmission mains, pumping equipment, purification plants and other utility property, on the other hand, in the same proportion that the value of the local mains in the system bears to the value of the balance of the utility property. This figure will be relatively constant from year to year for a given utility, but it will vary widely among different systems (6).

In making this division between local-main and total-plant investment, actual figures should be used when available. To assist in the application of this system of determining allowable investments, when definite cost figures are not available, "rule-of-thumb" or average figures could be developed for the relation between local-main investments and total-plant valuation. Obviously, this ratio would be vastly different for filtered surface water plants and plants using untreated ground water supplies. Consequently, the results obtained by the use of such rule-of-thumb factors at best could be expected only roughly to approximate the correct ratio. (Jackson (6) has said that, in the 28 utilities which he studied, the amount invested in distribution mains varied from $0.47 to $2.57 for each dollar in all other plant facilities.)

If, for illustrative purposes, it is assumed that the value of the local mains is equal to 50 per cent of the total value of the utility plant, it would appear reasonable that 50 per cent of the justifiable investment of $200 per

customer could be allocated to local mains and appurtenances. This would amount to 0.50 × $200, or $100.

Step 4: Determine the number of dollars which could be invested in local water mains (comparable to main extensions) for each dollar of utility revenue.

In the foregoing sections, it has been determined, on the basis of the several assumptions necessarily made, that an average annual revenue per customer of $40 would support an investment of $100 in local mains. In other words, for each dollar of annual revenue, the utility could invest $2.50 in local mains and their appurtenances.

Step 5: Determine the number of dollars which could be invested in a water main extension for each dollar of anticipated revenue.

It has been determined in Steps 1–4 that, on the basis of the necessary assumptions, an investment of $2.50 in local mains and appurtenances could justifiably be made for each dollar of annual revenue. Thus, if it is assumed that the average annual revenue per extension customer should amount to $24, the utility could contribute 2½ × $24, or $60, toward the cost of the extension for each anticipated customer and maintain the same rate of return assumed to be proper under Step 2.

It is likely that the application of this method of determining proper utility investment in main extensions will yield amounts which are far less than are now being allowed under currently applied extension policies. This situation results partly from the great increase in the cost of utility operation as compared with current revenues and partly from increased water main construction cost when related to the number of feet of main which can be built per customer within the limits of the proper investment.

Method B

A second method of estimating the investment which a utility is justified in making in an extension can be carried out with less effort than Method *A*, but in other respects it appears to be less desirable. Method *B* is based upon the philosophy that the utility can afford to invest the same amount in main extensions for each dollar of new revenue as it has invested in local mains and appurtenances for each dollar of present revenue from the entire system.

In applying this method, it is necessary to determine the amount of money which the utility has invested in local mains and appurtenances per dollar of operating revenue from existing customers. This amount is then multiplied by the additional revenue to be obtained from the extension, the result being the proper investment by the utility in a main extension.

For example, assume the value of the local mains to be $1,000,000 and the revenue from the system to be $400,000 annually. Dividing $1,000,000 by $400,000, it is seen that the investment in local mains is 2½ times the annual operating revenue from the system. Then, should the anticipated revenue per extension customer be $24 per year, under this method, the utility could invest 2½ × $24, or $60, for each new customer—the same figure as computed by Method *A*.

The undesirability of Method *B* as compared with Method *A* lies in the fact that, in using the latter method, a definite rate of capitalization can be assumed which the results obtained will reflect, while, with Method *B*, the rate of capitalization will be unknown unless the rate of capitalization of the entire system is known.

Computing Customer Deposits

There are two schools of thought regarding the proper basis to use in determining the cost of extensions as a basis for computing customer deposits. Some utilities make an actual estimate of the cost of building the particular main extension under consideration. Others adopt a standard estimating price for laying mains of various sizes, which is employed whenever no extensive special construction, such as stream crossings, is required. In the latter event, the standard prices are adjusted by adding the cost of the special construction to them. If the second method is used, the standard estimating prices should be adjusted from year to year so that they always will represent the average cost of construction.

In this connection, the committee has briefly considered several questions without reaching, or even approaching, a concerted opinion. Comments from the industry will therefore be of particular interest to the committee. The questions are listed below:

1. If a main larger than the minimum is made necessary because there is little or no usage between prospective extension customers and the connection with the existing system, should customers be charged with the cost of the actual size of main required or should the deposit be based upon a main of minimum size?

2. If a larger size than the minimum is required because of a wide grid or long blocks with customers distributed along the entire length, should the charge be based on the minimum size of main or on the larger size?

3. Some promoters prefer to make outright contributions in aid of construction rather than to post a deposit subject to later refund. When such contributions are suggested, what position should be taken by the utility? Are contributions desirable under these circumstances? If so, what should be their amount as compared with the deposit?

Determination of Proper Refund

The deposit refunded for additional customers can be based either upon the actual water bills paid by the new customer over a period of time sufficient to indicate the amount of his annual water bill, or upon an amount estimated at the time the deposit is made. Both methods have been used successfully. In either event, the amount of the refund can be determined by multiplying the annual water bill (either actual or estimated) of the additional customer by the same multiplier that was used in determining the proper investment in the extension. It should be noted, however, that the multiplier should here be applied only to the revenue obtained from the customer and not to the average revenue on which the free extension was based. The reason is that the average figure includes revenue from sources other than the individual customer—such as hydrant rental and the like—which will not accrue from the new customer.

Policy on Private Mains

Some members of the committee favor definite prohibition of private mains under any circumstances. Other members, however, feel that circumstances may exist in which water actually is needed but it is not practicable or desirable to install a public main. In such situations, it appears to these members that there should be a method by which water service could be obtained. The committee also invites comment on this problem.

Shop and Field Inspection of Steel Water Mains

By Edward J. Clark

A paper presented on June 2, 1949, at the Annual Conference, Chicago, by Edward J. Clark, Chief Engr., Bureau of Water Supply, Dept. of Water Supply, Gas & Electricity, New York.

THIS paper will discuss briefly various aspects of steel water pipe inspection procedure that seem of primary importance. The suggestions given herein are based upon practical experience in New York City, under the pavements of which there are approximately 105 miles of steel pipe. Coated and lined steel water pipe has been used in all sizes up to 84 in. in diameter for over 40 years in New York City. These pipes are secondary arteries in the city distribution system, as the main feeders are concrete-lined tunnels 11–21 ft. in diameter, lying 80–750 ft. below the surface and cut through solid rock.

As New York's experience obviously is not all-inclusive, this paper must be incomplete. Nevertheless, the author hopes it will be the forerunner of other papers on the subject which will ultimately provide a complete inspection procedure for those who are constructing steel water lines.

In the narrow sense, the examination of steel pipelines is primarily the work of inspectors who watch and check detailed procedures. It is evident, however, that the skill of a single inspector or engineer does not suffice and that, after a steel pipeline has been designed and contracted for, everyone representing the owner is, in the broad sense, an inspector of part of the process. The "inspection of steel pipe," consequently, cannot be an isolated function but demands an organization in which the various individuals and inspectors are important cogs in a well oiled machine. The New York Dept. of Water Supply conceives of the inspectional function not merely as one of rejection or acceptance of work, but also as one of active participation and cooperation during the entire progress of a project.

The first suggestion offered, therefore, is to set up the proper organized procedure. The importance of this point cannot be overstressed, since better results can be obtained by a smoothly working team of individuals of average ability, with a system of checks and balances, than from the disjointed efforts of geniuses. Furthermore, very few men are geniuses.

New York Procedure

When a steel pipe is to be constructed in New York City, the following is the procedure after the contract has been let: The "geometry"—that is, the exact plan and profile of the proposed pipe—is prepared by the field engineers who are to supervise the construction and is then turned over to the contractor for the preparation of the shop drawings. When the latter have been made, copies are simultaneously sent for checking to the designing and field engineers. The de-

signers check for strength and to assure that the details conform to the requirements of the specifications. The field engineers check all measurements to minimize the errors of fitting in the field. After the shop drawings have been approved, copies are sent to the materials inspection division, to which the shop inspectors report directly. By the time these inspectors receive the fabrication drawings, therefore, everyone connected with the construction of the line has become thoroughly familiar with the work to be done and has had an opportunity to apply his special skill to the correction of errors.

Daily reports are submitted by all shop and field inspectors. The inspectors in the shops have two forms: one, which is kept for the records, to be used as required, is a detailed story of everything that transpires; the other, which is submitted daily to the central office, is a summary of the results and progress for that day. Furthermore, as pipe is shipped, a combined shipping schedule and inspector's report is submitted to the central office, which transmits it to the field forces and the contractor. In this manner, both the central and field offices have a running account of progress and can immediately sense and take corrective steps if snags are developing, if fabrication schedules are out of line with construction schedules and so forth. This coordination is vital. At times, for example, all the straight pipe delivered may be useless without the specials and must remain stored in the field with consequent delay to the work and damage to the coating.

A similar system is used in the field, where a record is kept on daily forms of the labor, equipment and material used by the contractor, and the difficulties encountered, such as weather, subsurface structures or traffic. Field notes and diagrams are made of all work, as actually performed by the contractor, from which record drawings are prepared, giving a complete story of the pipeline installation.

The inspector's notes and record drawings are invaluable as a reference for future connections or other public utility subsurface construction, and for use in possible lawsuits.

Supplementing and forming an integral part of the above procedure is the department's well known policy of getting acquainted and cooperating with the personnel at all levels—in the shop and in the field—who are responsible for executing the work. Experience indicates that this broader, more "human" approach is very helpful in many respects. Many contractors, for example, submit lower bids as soon as they realize that the department will aid them in their engineering and do everything possible to minimize red tape.

Periodic visits by responsible department heads are made to the various shops and foundries, in order to inspect plant adequacy and facilities and to establish the proper personal relationships. This procedure has, on occasion, been the means of expediting the work and saving the city considerable money because good relations had previously been established with manufacturers doing work on city contracts.

Qualifications of Inspectors

An organization is, of course, no better than the individuals of which it is composed. The criteria used by the department as a guide in the selection of personnel include:

1. *Integrity and loyalty to the department and conscientious attention to duty.* This criterion is paramount, since even great ability on the part of an individual cannot compensate for lack of these virtues. Inspectors must have a certain tough-mindedness and be on the job every minute. No job can be inspected from inside a hotel room, shanty or parked car. Disloyalty on the part of an inspector is a dangerous weapon being used against the department, and no inspector at all is preferable to such an individual. No inspectors have ever been fired by the department for making mistakes but "goldbricking" is unpardonable.

2. *Tact and patience.* An employee who possesses these qualities can keep a job moving smoothly and efficiently with a minimum of friction, whereas an employee without them can do immeasurable damage. A technically well qualified but tactless field engineer once so antagonized everyone connected with a steel pipe project that delivery of the pipe was greatly disorganized and the contractor's force and equipment were periodically made idle, with considerable loss to all concerned.

3. *Sufficient knowledge of engineering, construction and work procedure.* It is obvious that an individual cannot supervise any procedure in the construction of steel pipe without adequate training and experience.

The next suggestions concern the detailed procedures to be followed in the shop and in the field.

Steel Plate Quality

It is usually impractical to assign an inspector at the steel mill to inspect the ingot and plate from which the pipe is to be fabricated, and certified reports of chemical and physical properties are accepted in lieu of such inspection. The inspection department should examine these reports carefully, however, to be certain that all heats meet the specifications, as trouble may be caused later in the project from one or two bad heats which can creep in unnoticed because it was taken for granted that the steel was up to specifications.

Fabrication of Pipe and Specials

Before mass production is permitted in a shop, it is essential that the plant have adequate equipment to assure that the finished product is acceptable. Specifications should provide for trial tests upon which approval of the manufacturing process is to be based. The welding rod to be used should be checked to make sure that it is of a quality which will insure thorough penetration and sound welds. Edge preparation of plates should be checked so that they will be in proper alignment for welding. Care should be used to assure that all surfaces to be welded are thoroughly free from rust, scale and dirt before welding. Flat spots along the longitudinal seams must be adequately corrected by dies of proper radius. Specimens should be cut from the pipe and tested, as required by the specifications. All welds should be visually inspected. All dimensions, radii, locations of fittings, bolt and rivet holes and the like should be carefully checked against approved shop drawings. The ends of all pipe should be measured with a circular gage before leaving the shop, to insure proper fit at the joint. All pipe and specials should be tested hydrostatically, in the presence of the inspector. Each length of approved pipe that

leaves the shop should be marked plainly by the inspector.

Pipe Coating

Before permitting application of the coating, all pipe should be checked to see if it has been thoroughly cleaned, and samples of the coating should be taken and analyzed to assure that it meets the requirements of the specifications. Care must be taken to insure that the primer has time to set before the hot material is applied, and that too much time does not elapse between primer and coating applications. New York City specifications require a minimum of four hours and a maximum of 96 hours for this period. Tests for thicknesses of the lining should be made immediately after each pipe length leaves the coating machine and before the electrical detector is applied. The ends of pipe sections should be inspected before loading for shipment, to see that they are cleaned back the required distance.

Transporting Pipe

Damaged coating and out-of-round pipe always cause construction difficulties, and subsequent field replacement will be minimized if the pipe is loaded, unloaded and field-handled carefully. Suitable skids or blocks should be placed under each pipe in the shop and storage yard and during transportation, and the pipe should always be braced on cars so that it cannot roll, shift or bounce. For light-wall pipe of large diameter, internal bracing is necessary to prevent distortion.

Coated pipe should be loaded with slings wide enough to prevent damage to the coating, and all methods of handling or storing pipe which could cause damage to the pipe or coating must be avoided. In particular, the pipe must not be deposited on boulders or uneven ground.

Laying Pipe

The details which must be checked during the laying of a steel pipeline in a city, with its multitude of underground structures and special traffic conditions, are so numerous that only a brief account of some of them can be given in a paper such as this one. A few of the problems which are most commonly encountered include:

1. *Protection of strung pipe.* Precautions should be taken to protect pipe while it is lying alongside the trench. Except when unavoidable, no pipe should be left on a city street overnight or more than six hours before laying. If necessary, special watchmen should be provided. Children have been known to build fires inside pipes or throw rocks at and carve initials in the coating. The insides of pipes are sometimes polluted by humans as well as animals. Coated pipe should be whitewashed at the place of manufacture to prevent damage from exposure to sunlight.

2. *Excavation of trench.* Machine excavation should be permitted only to a point about 6 in. above finished grade. The remainder, to finished grade, should be done by hand. When the trench is in rock, no rock should be allowed to project nearer than 6 in. to the bottom or 12 in. to the side of the pipe; and before laying, the bottom of the trench should be filled with clean earth, thoroughly compacted to the underside of the pipe. If cinder fill is encountered in the trench, it should be removed and replaced with

clean earth for at least 6 in. all around the pipe.

3. *Traffic conditions.* The work, in general, should be arranged so that not less than half a roadway is open to traffic at all times, and trench bridging should be provided where required at intersections, crosswalks and driveways. Under particular traffic conditions, it may be necessary at various locations to do the work during special hours—for instance, on Saturdays, Sundays and holidays or at night.

4. *Laying practice.* In laying steel pipe, precautions should be taken to prevent injury to the coating. Inspection and repair of the coating on the bottom of the pipe must be made prior to lowering it into the trench. No person should be permitted to walk on or in the pipe wearing boots or shoes with hobnails or other such attachments. Joint holes should be dug prior to lowering the pipe into the trench. At the close of work each day, and when laying is not in progress, the exposed ends of pipe should be protected with temporary wooden bulkheads. If riveted pipe is used, the reaming, calking and tightness of rivets should be carefully checked. If mechanical couplings are used, the roundness of the pipe ends should be checked on the bank. Care must at all times be taken to prevent flotation of the pipe through water entering the trench while the pipe is being laid or during the flushing of the backfill. Pipe should always be maintained under hydrostatic pressure when concrete is being placed around it. Care must be taken that the coating at the joints—and elsewhere, when damaged—is repaired prior to backfilling. The trench should be backfilled with clean material, which, to a height of at least 1 ft. above the top of the pipe, must be free of stones larger than 3 in., to prevent damage to the coating. The backfill should be thoroughly tamped or flushed to insure consolidation.

Final Steps

The final three steps are: [1] hydrostatic test for leakage; [2] examination and electrical testing of the interior coating; and [3] disinfection of the main.

The design of the line will, of course, have provided the necessary aircocks, blowoffs and manholes required for the purpose of filling, venting or draining the line. If the proper precautions are not taken in these operations all the care exercised in the fabrication, transportation and installation of the pipe may be nullified. In filling, the aircocks must be open, the blowoffs closed and the water admitted slowly. In emptying, the formation of a vacuum must be prevented by first opening the aircocks and then controlling the rate of flow through blowoffs.

Engineering literature records that the collapse of steel pipe has resulted from failure to observe these precautions, and workmen, therefore, must be carefully briefed in this regard.

In blowing off mains through hydrants, all areas downhill should be carefully inspected to make sure that there is adequate and proper drainage and that there are no men from utilities or sewer bureaus working in manholes who might be trapped.

In determining the rate of leakage at test pressure (in New York City, 125 psi.), the amount of water pumped to compensate for leakage should be measured volumetrically and not through a meter. New York City allows a maximum 24-hour leakage of

approximately 0.03 gal. per linear foot of main for each foot of pipe diameter.

As a final precaution, the cleanliness of the pipe is verified by laboratory analysis of water samples taken from the main.

The above general outline is offered as a guide for obtaining good results in the construction of a steel pipeline, and specifications should be so written that the detailed procedure flows almost self-evidently.

Discussion

F. M. Randlett

Vice-Pres. & Gen. Mgr., Robert W. Hunt Co., Chicago.

The energy and expense incurred in preparing specifications for materials, together with descriptions of the work to be done, are wasted unless a real effort is made to see that the materials comply with the requirements.

Inspectors must be selected who are capable of being shown how to understand the specification requirements and the tolerances permissible. They must be trained to judge good workmanship, attention to dimensions and speed of production. Practical experience and intelligent instruction are required to qualify a person to perform useful and efficient inspection, with attention to all details in keeping with the contracts.

The main purpose of inspection is to see that all the requirements of the specifications and plans are properly fulfilled. Very expert judgment is required in order to determine where minor flaws leave off and injurious defects begin, taking into consideration the purposes for which the material is to be used. It is also important to determine whether the defects can be repaired or whether the pipe should be rejected entirely. If repair is permitted, the inspector should see that it is properly done, in accordance with the requirements of the contract. Checking dimensions, testing, marking and weighing are, of course, part of this procedure.

Items to Be Checked

The coating materials used will depend on the specifications but, in any event, will require proper cleaning of the pipe before application, removal of all mill scale, and application under cover to guard against weather conditions and foreign matter. The nature and extent of the precautions will depend on the type of coating and the temperature at which the application is made.

Unless the specifications are very definite, the loading, unloading and transporting of pipe and appurtenances will generally be done in accordance with the practices of the particular contractor. An inspector cannot change these procedures except when they are at variance with the specifications.

Pipe must be lifted or rolled without damage to the coating or ends and should rest on skids of proper width, depending on the weight per foot of pipe. The specifications should cover this feature in detail.

Pipe and appurtenances must be properly bedded and tamped in fine material, preferably sand, to at least the spring line or lower half of the diameter of the pipe. The same material and tamping should be continued to approximately 1 ft. above the top of the pipe. Grades and alignment

should be carefully followed. Under certain conditions tile drains, open at low points, should be installed in the trench below the bottom of the pipe, to carry off any moisture that might collect and be retained around the pipe. Joints should not be backfilled until after the required hydrostatic tests have been made. All joints, fittings, valves and appurtenances should be in place when hydrostatic tests are made on the finished line. Attention must be given to proper operation, packing and drainage, if necessary.

Field coating and patching should be kept to a minimum but, when required, should be applied on properly cleaned surfaces at proper temperature and with proper materials as specified.

The author states that, for light-wall pipe of large diameter, internal bracing is necessary to prevent distortion. The writer believes it would be wise to specify the pipe thickness and diameter requiring internal bracing. Coated pipe, according to the author, should be loaded with slings wide enough to prevent damage to the coating. This statement is, of course, correct, but in the writer's opinion, the width of the sling should be specified for a certain weight per foot of pipe.

For backfilling, the author states that the bottom of the trench should be filled with clean earth. Clean sand is preferable, if it can be obtained. It is also suggested that the prohibition against walking on or in a pipe while wearing boots or shoes with hobnails should be amended to permit this practice only when wearing boots with rubber soles or rubber protection of some sort.

The size of the pipe, pressure, kind of water, nature of soil and other items must be covered in the specifications and contracts, and it is the inspector's duty to see that their provisions are carried out. Improper workmanship, low-quality materials and improper installation should be avoided so that breakage and repairs and poor service can be eliminated to the greatest extent feasible. The specifications and contracts should be as explicit and unambiguous as possible. Attempting to keep first cost low at the risk of incurring later expense for maintenance of installations and continuous service is uneconomical.

Russell C. Beam

Mgr., Welded Pipe Sales Div., Armco Drainage & Metal Products, Inc., Middletown, Ohio.

The water works engineer is indebted to the author for his paper on the inspection of steel water mains, a subject of much importance about which a great deal can be written. This discussion will attempt to supplement the author's suggestions with information regarding shop inspection based on the writer's experience in the manufacture of steel water pipe over the past 25 years.

As far as shops or pipe-manufacturing plants are concerned, inspectors generally fall in two main groups: First, there is the inspection department of the plant itself, which is responsible for the quality of the pipe shipped whether or not there are outside inspectors on the project. Then, there are the outside inspectors, most of whom come from regular inspection companies. There are a few, however, who are directly employed by the city or municipality buying the water line.

Open-hearth furnaces, continuous mills and pipe-manufacturing machin-

ery have an individuality to be reckoned with, just as do the millworkers, salesmen and customers. Such equipment has eccentricities and moods which may cause the product to be substandard or above standard. The steel pipe mills themselves have understood this situation and many years ago established their own staffs of inspectors and necessary laboratories. Their job is to see that the pipe shipped meets the standard specifications submitted by the customers with their orders.

It is interesting to note that in 1948 over 7,000,000 tons of steel pipe and tube were shipped into all markets. This tonnage represents 10.4 per cent of all the steel shipped from the mills during that year. It is self-evident that steel mills must have competent inspectors and laboratories to handle such a large tonnage, and, of course, steel water pipe receives the benefit of this elaborate inspection system.

Inspectors from regular inspection companies and municipalities are generally referred to the mill inspection department to handle the order under consideration. The chief inspector at Armco Drainage & Metal Products, Inc., has given the writer some first-hand observations about outside inspectors:

Some inspectors we get are very conscientious and watch with interest every operation from the making on pipe machines to the loading in cars. Everything that we do to a piece of pipe is checked by them. Also everything we tell them we do is checked and inspected until they are firmly satisfied that we are doing a quality job and are reliable in what we say we are doing. When they are satisfied that they are getting quality, inspection as far as every detail is concerned is decreased to a spot check.

Another type of man that we occasionally get as an inspector is one who seems to be interested mostly in having his stamp put on the pipe and will let anyone put it on, regardless of whether he has personally seen the pipe tested, inspected, coated or anything else, as long as he has been here or is in the plant while the pipe is being made.

The most aggravating type of inspector is one who comes into our plant absolutely green as to what he wants, and before he can do any inspecting we have to sit down and take the time to explain everything to him and also show him actual conditions. In other words we have to give him a liberal education on what to look for. This type of man takes a lot of time.

The writer is glad to report that the majority of the outside inspectors coming into the plant are well qualified men.

Based on experience, it is believed that inspection can be improved if the plans and specifications for steel water pipe are better prepared. For years the writer has seen plans and specifications for many projects designed in various ways and according to different standards. A situation of this kind complicates inspection.

In January 1948 the JOURNAL published an article by R. E. Barnard (1) on design standards for steel water pipe of 6-in. to 36-in. diameter. The use of these standards in plans and specifications for any project should be encouraged as they give the inspector a useful reference guide on steel water pipe.

In addition, the engineer in charge of the preparation of specifications for a steel pipe project can be more helpful to all concerned if he observes the supplementary details required by A.W.W.A. specifications for steel wa-

ter pipe and coatings (Sec. 3–1.2 of 7A.3 [Ref. 2]; Sec. 4–1.2 of 7A.4 [Ref. 3]; Sec. 5–1.3 of 7A.5 [Ref. 4]; and Sec. 6–1.3 of 7A.6 [Ref. 5]). A few of the details to be specified by the engineer that are not always clear are the allowable laying length of pipe sections and the working water pressure of the pipeline. Frequently the laying length of valves and the drilling template of valve flanges are overlooked. Complete supplementary details written into the order specifications at the start would clarify inspection procedure and save time and money for everyone involved.

There are now available eight A.W.W.A. specifications pertaining to steel water pipe and coatings, which are in daily use throughout the country. Undoubtedly some sections of these specifications can be improved, based on the experience of inspectors, and there is a definite procedure that can be followed in submitting such constructive criticism. A report should be made to the Secretary of the A.W.W.A., who in turn will refer the matter to Steel Plate Pipe Committee E7A. Subsequently the matter will be brought before the Steel Water Pipe Manufacturers Technical Advisory Committee. In the latter group are several subcommittees of qualified men who can take constructive criticisms of specifications, work them into suitable form for approval by the parent committee, by Committee E7A, by the Water Works Practice Committee and by the A.W.W.A. Board of Directors.

Actually this procedure is not as cumbersome as it might appear. It assures, however, that any revisions made after review as outlined are good for the water works profession because they have received the greatest consideration possible. Inspectors should assume the responsibility of calling attention to sections of the A.W.W.A. specifications which they think should be improved.

References

1. Barnard, R. E. Design Standards for Steel Water Pipe. Jour. A.W.W.A., **40**:24 (Jan. 1948).
2. Standard Specifications for Electric Fusion Welded Steel Water Pipe of Sizes 30 Inches and Over—7A.3–1940. Am. Water Works Assn., New York (1940).
3. Tentative Revision of Standard Specifications for Steel Water Pipe of Sizes up to But Not Including 30 Inches—7A.4–1941–TR. Am. Water Works Assn., New York (1943).
4. Standard Specifications for Coal-Tar Enamel Protective Coatings for Steel Water Pipe of Sizes 30 Inches and Over—7A.5–1940. Am. Water Works Assn., New York (1940); Jour. A.W.W.A., **32**: *following p. 180* (Jan. 1940).
5. Standard Specifications for Coal-Tar Enamel Protective Coatings for Steel Water Pipe of Sizes up to But Not Including 30 Inches—7A.6–1940. Am. Water Works Assn., New York (1940); Jour. A.W.W.A., **32**: *following p. 180* (Jan. 1940).

Water Department Operation Under City Manager Administration

By G. E. Arnold

A paper presented on May 30, 1949, at the Annual Conference, Chicago, by G. E. Arnold, Director, Water Dept., San Diego, Calif.

AN increasing number of American cities are adopting the city manager form of government. The International City Managers Assn. reports that, as of April 1949, 877 American cities were under the manager form. Of these, more than 30 have a population in excess of 100,000. The author wrote to sixteen such cities for information regarding water department operations, and this paper will be a composite of the replies returned but must of necessity frequently cite San Diego situations.

It was the author's privilege for nearly two years to serve as assistant city manager of San Diego, a position which gave him an opportunity to study the operations of all of the municipal departments. Now, as head of the San Diego Water Dept., the author finds that his previous experience is valuable in correlating the work of the water system with other city departments.

San Diego has been under a city manager for many years, and the relationships of the various departments to each other have been harmonious. It should be noted that the extent of the city manager's control varies from city to city with regard to the number of municipal functions under his supervision. It is surprising to note how many departments are involved in the operation of a water utility. In San Diego there are 26 which have some direct relationship to the water department, a few of which are mentioned below.

Interdepartmental Relations

The mayor and council are the legislative body of any city government and establish the policy and set the rules and regulations under which all departments operate. The mayor and council appoint the city manager, who is the administrative head of the municipal government. Usually the city manager appoints the department heads under his direction, the latter being responsible to him for their operations. If most of the departments of a city government come under the direction of a manager, he can readily correlate interdepartmental activities and eliminate friction, which is frequently done through department head conferences held regularly in the manager's presence.

The auditor-comptroller is in charge of the administration of all city funds, including water revenues, and must be equipped with suitable legislation in the form of a resolution or ordinance to authorize expenditures. It is also his responsibility to determine the availability of funds before expenditures can be made or contracts entered

into. The auditor is responsible for examining the books of the water department to see that all funds are accounted for and all expenditures legally made. The water department must have close cooperation with this official, as no organization can function long without money.

The city attorney and his staff are charged with the legal interpretation of the city charter, and with other legal matters. A great deal of the water department's legal work must be handled by his office. San Diego has a very complex situation involving the source of water supply, and one of the members of the attorney's staff is assigned practically full time to water matters. Frequent conferences with the city attorney and his staff are necessary.

Most American cities operate under the civil service plan for municipal employees, including, of course, water department personnel. The civil service department is responsible for selecting the proper men for the various operations. Requests for personnel are made to the civil service office, outlining the duties and the qualifications needed to fill the position. Competitive examinations result in the establishment of an eligible list from which personnel is drawn. Most cities permit the department head to have his choice of the three highest individuals on the eligible list, but some confine him to the top man on the list. It is the author's opinion that the leeway of three is desirable.

Public Works Divisions

The public works department of San Diego has several divisions which operate closely with the water department. The electric division, which contains trained employees and much specialized equipment, does most of the installation of electrical equipment at water system stations and maintains and repairs all electrical equipment throughout the department. The public buildings division also has a close relationship with the water department through its function of maintaining and operating the buildings belonging to the city. The sewer department, also under public works, occupies the streets with the water department and uses large quantities of water in flushing and treatment work. Close cooperation between these two departments is necessary in the elimination of potential cross connections or other hazards to the water system.

The shops division in San Diego owns and maintains all of the power equipment of the city, as well as the automotive equipment, which it leases to the other departments. Generally, specified equipment is permanently assigned to other departments, but heavy construction equipment is made available as needed, in order to avoid duplication. In an emergency, the water department has the first priority for any heavy equipment required.

The street division is, in a way, the host to the water department, as most of the water lines are laid in public streets. Clearances must be obtained from the street division for any new installation or change of existing installations of the water department. The street department, having the necessary equipment, makes all pavement repairs for the water department, the latter reimbursing it for the cost.

The city engineer has many responsibilities which call for close cooperation with the water department. His office must establish grades on streets where mains are to be laid and must

keep records of all dedicated streets and the structures in them. This information must be available to the water department, which should provide the engineer's office with up-to-date information on the water plant, so that there will not be a conflict with sewers, storm drains or other structures. The city engineer's office furnishes the base maps on which water department lines are plotted, as well as the tie-point sheets to which these facilities are indexed. Improvement proceedings are handled by the city engineer's office and should be carried on with the cooperation of the water department.

The opening or closing of dedicated streets should be cleared by the water and sewer departments. At times, after previously dedicated but unused streets had been closed without notifying the utilities involved, it was discovered that a water main or sewer was in the street, for which there was no right of way. As a result of one or two sad experiences of this type, clearances were arranged and this difficulty was avoided. The procedure also includes checking with the planning department.

Fire Department

The fire department has a very close relationship with the water department in that a good water supply is the first prerequisite to the control of fire. Plans for the improvement of the water system should be checked by the fire department. Hydrants are usually requested by the fire department and installed by the water department. A hydrant rental charge should be made by the water department against the fire department, and this charge should be paid by an actual transfer of funds. This practice will help to keep the fire department in line in requesting hydrants. Many cities have the policy of instructing a gateman to report at all large fires to regulate gates for the control of water. This man should be equipped with an emergency truck and should report to the chief in charge at each fire. Records of all gate operations should be kept by the gateman.

Most of the other cities queried in preparing this paper indicated that they made no fire hydrant rental charge. In the author's opinion, this failure is a serious deficiency in water utility operations. The utility should receive compensation for the water used for fires and for the standby facilities required to provide adequate capacity for fire protection. Without the necessity for adequate main sizes to meet fire conditions, most water systems could be operated much more cheaply than they now are. The additional cost involved should be borne by those benefited.

Other Departments

The health department has a definite responsibility for the quality of the city water and in most cities makes regular tests of the water supply in its own laboratories. In the larger cities, as well as in some of the smaller ones, the water department also makes its own tests. A fine cooperative program can and should be built up by the water and health departments, and the water department should join with the health department in the determination and enforcement of good plumbing standards.

The park department is frequently the water department's largest customer. All water supplied to public parks should be metered and charged to the park department. Plans for enlarging or improving public parks should be checked by the water depart-

ment to see that adequate water facilities are available for the proposed change. The park department frequently calls on the water department to lay and sometimes to maintain water lines within the parks, a service which should be rendered by the water department to the park department at cost.

The planning department has a vital function to perform in connection with water department operations, since it clears all proposals for subdivisions. The layout of the water system in a new subdivision should be referred to the water department for approval and should be installed under its supervision. In San Diego, the subdivider is required to file a plan of his subdivision showing all the water, sewer, street, curb, sidewalk and other facilities. These plans are referred to the water department for clearance and approval before the planning department will authorize the subdivision. During installation by the subdivider, complete inspection of all water facilities is required by the water department. Sometimes the inspector for the street, sewer and other departments is used by the water department, and his reports of the installation are submitted to the water department so far as they relate to water facilities. The water department refers its long-term projects for extensive improvements to the planning department so that the latter will be advised of proposed changes.

The police department has a definite function in the operation of the water department through the use of its radio system. In addition, the police department should be called on to assist the water department by reporting leaks or similar occurrences, as well as any unauthorized use of water by contractors or others. The police are constantly patrolling the streets and can be of invaluable service in looking out for matters of interest to the water department. In San Diego the police department operates a photographic laboratory which is used by all city departments, including the water utility. The water department should also report to the police department any leaks that occur, so that police patrol cars and motorcycles may be advised of possible danger. It is necessary at times to call on the police department for assistance in the direction and control of traffic during street excavations and the like.

The purchasing department is responsible for the procurement of all materials and supplies, and sometimes opens bids for construction work and awards the contracts. In most cities, the purchasing department maintains a store of supplies for all other departments. In small and medium-size cities this practice is satisfactory, but for larger cities the water utility must have extensive stores, and it is felt desirable to let that department do its own purchasing and maintain its own warehouses.

Most larger cities have a real estate agent or right-of-way man who obtains and sells any real property for city departments. This individual has a great responsibility in obtaining satisfactory rights-of-way for utility lines, particularly in those areas outside of the city limits where water facilities cannot be laid in public streets.

Cooperation Essential

The water department performs a number of functions for other departments in addition to that of furnishing water. In San Diego, for example, it does all of the mailing for other de-

partments in the Civic Center Building, thus avoiding the necessity of keeping a supply of stamps or postage machines in other departments. The water department fell heir to this function because of its extensive mailing of water bills. The water department in San Diego also assigns all house numbers. As the availability of a water supply is the initial prerequisite to building, all persons come to the water department first for their house numbers and a service clearance before obtaining a building permit. The water department must maintain close contact with the city engineer's office and the planning and post office departments in naming streets and assigning house numbers.

Cooperation between the various departments can best be brought about by frequent conferences as suggested above. If other department heads are familiar with the problems of the water utility, they will be quick to cooperate in the event of emergency.

An example of cooperation between departments can be illustrated by an incident during the summer of 1948. About the middle of July a fire broke out near one of the water department reservoirs southeast of San Diego. Within two days this fire had burned over a large area and had destroyed three flumes of the Dulzura Conduit, which carries water between two reservoirs. The fire also destroyed the power and telephone lines and burned some of the buildings at the reservoir. The restoration of water service through this flume was imperative, and within a matter of hours the author called on several of the divisions of the department of public works for assistance.

Early the next morning a crew from the electric division was on the job stringing new wire and setting up poles to restore power and communications. That same day a foreman from the building division arrived and surveyed with the water superintendent the work necessary to replace the flumes. A list of materials was made up, the equipment and personnel needed were outlined and requisitions for the purchase of the material were immediately made. The purchasing department swung into action with a thorough survey of the lumber yards of the San Diego area for the procurement of the necessary items. A special meeting of the council authorized the purchase of the materials in the open market without calling for bids and, by the second day after the fire, materials were being delivered at the site.

A crew was immediately made up to clear away the remnants of the old flume and to start cutting timbers for the new construction. An emergency camp was set up that night and for about a month the men stayed right on the ground in tents, being fed and housed by city personnel from other departments. Truck drivers, carpenters and mechanics of all kinds were put to work. Trucks, cranes, bulldozers and heavy equipment were taken from other jobs around the city and sent to the area of the fire for the reconstruction work. The 40-hour week was temporarily forgotten and the men put in six ten-hour days a week in completing this work. A contractor was engaged to place roofing paper linings in the new flumes as they were built. In a little over a month the flumes were entirely rebuilt and placed in service. Complete cooperation was received from all departments affected, and the job was carried through successfully in a minimum of time.

Utility Problems

A review of the functions of the various departments in several different cities indicates that most municipalities have the same general problems. One of these is water main extension policy, which varies widely in different localities. Some cities subsidize all water main extensions, while in others the customer must pay all the cost without reimbursement. It is realized that extension policies are governed to some extent by the financial situation of the city, but it is the author's opinion that there is too much divergence of practice in this important matter. Likewise, the amount of centralization of equipment and functions seems to vary greatly from city to city. Every water utility should carefully review the cost of ownership and maintenance of heavy equipment, operation of chemical and photographic laboratories, mimeographing or printing activities and other functions of this type. Except in the largest cities, where the water utility is of sufficient size to warrant independent facilities, it is felt that definite economies can be effected by centralizing such operations, and it has been San Diego's experience that satisfactory service can still be rendered with the cooperation of other departments.

The foregoing illustrations have been presented for the purpose of demonstrating how a water utility should operate under any type of municipal administration. It is believed that under a city manager the water department functions smoothly. Under other forms of administration it should function just as well but frequently does not. In the strong-mayor form of government, the mayor is the executive head of most of the city departments and can perform the same functions as the city manager, but the mayor must be mindful of his political situation, and the correlation of interdepartmental activities is sometimes hampered by the dictates of political expediency. In the commission form of government, each commissioner tends to perform his functions independently, and, although there is usually good cooperation between commissioners, no overall executive head of the city government exists who can issue the orders necessary for smooth operation. The city manager is not affected by politics in a well organized administration and is in a better position to bring about the smooth operation desired.

The one outstanding feature of practically every water utility is that it is called on to subsidize other city operations because it has its own source of revenue. The absence of a fire hydrant rental charge is an example of this situation. In many cities the revenues of the water department are transferred to the general fund of the city for the use of other departments, which sometimes leaves the water department without the necessary capital for plant improvements when needed. It is noted that in some states the law prohibits the accumulation of a surplus by publicly owned utilities. To the author's mind, this policy is absolutely wrong and should be corrected. Until about two years ago the San Diego city charter required that all earnings of the water department be transferred to the general fund of the city at the end of each month. This provision prevented the department from accumulating any funds for capital improvements, practically all of which had to be financed by bond issues. A charter amendment approved by the

people in 1947 corrected this situation, so that the water department can now accumulate surplus for future capital expenditures. Because of the heavy expenditures needed to keep the system operating under the recent increase in population, the utility has as yet been unable to retain any surplus, but the time will come when its ability to do so will be of material advantage to the San Diego water department.

In the author's opinion, it is of outstanding importance for the water officials of the nation to engage in a campaign to eliminate the diversion of water department earnings for subsidizing public improvements or the operation of other city departments. Under the city manager form of government, the cooperation of the various departments can and should be readily obtained and the development of the water works industry can be materially aided.

Discussion

Reeves Newsom

Village Mgr., Scarsdale, N.Y.

Like the author, the present writer, in discussing the subject of water department operation under city manager administration, will have to refer to his own municipality and the way water supply and other departmental functions are carried on there.

The author noted the growth in the use of the manager form of administration among American cities and mentioned that 877 communities had adopted it. The writer must correct that statement by adding one to this figure, as Scarsdale, N.Y., is not included in the published total. Although Scarsdale has a manager, the position was not established by adoption of the statutory council-manager form of government and, therefore, under the by-laws of the International City Managers Assn., it cannot be included in the total.

The position of manager was created in Scarsdale by the passage of a local law so general in nature that the scope of the duties and responsibilities of the manager is greater—in relation to those of the governing board—than it would be under the usual council-manager form. Incidentally, although the village covers 6½ square miles of area and has over 80 miles of streets, in excess of $70,000,000 of assessed valuation, and a gross annual budget (not including schools) of more than $1,250,000, Scarsdale has preferred to continue to operate as a village instead of becoming a city. The reason is that the village law of New York State, being designed primarily for small communities, is simpler and more flexible than the city law and lends itself better to the type of municipal operation which the inhabitants desire.

Municipal Administration

The local law as adopted is quite brief. It provides that there shall be a manager; that he shall be the executive assistant to the Board of Trustees in carrying on the affairs of the village; that, within the limits of the budget and civil service procedure, he may employ the necessary personnel, other than officers whom the board appoints when vacancies occur; and that, within the limits of the budget, he may purchase materials and equipment and employ the services of persons other than regular employees as needed, except when the law requires

calling for bids. As the latter requirement, under the state village law, applies only to the construction of public works costing over $2,500, it is apparent that the manager in Scarsdale has a wide range of authority.

Taken in conjunction with the fact that the Village Board of Trustees, which also functions as a water board, is, without exception, made up of men of large affairs who are not only nonpartisan but who do not engage in personal politics, this situation makes for the maximum of efficiency and the minimum of interference in the administration of the municipality's affairs. The continuation of this type of board is assured by the method of selection of the mayor and trustees. These officials are nominated by a community-wide committee, set up in accordance with procedure agreed on by the various civic and neighborhood associations, under the executive direction of the largest of these—the Town Club—which has about 1,000 members and has been functioning as an active, working civic group for 44 years.

The mayor and trustees are selected without their prior knowledge and are then requested to serve as an honor and a civic duty, but without compensation, for a two-year term, with renomination possible for only one additional term as trustee and no second term as mayor. Nomination is equivalent to election because rarely are as many as 200 ballots cast on village election day. The three tickets—Republican, Democratic and Citizens—carry exactly the same names. Furthermore, the nominees know that under the manager type of administration, as it operates in Scarsdale, little will be required of them beyond the time needed to attend two regular evening meetings per month, the summer excepted, and an occasional committee meeting. Under the circumstances, those selected rarely fail to accept. Conversely, no citizen who evinces any active desire to be on the board is selected.

It is a situation in which no one can run for, or run away from, a position on the board and one in which the appointment of department heads and officers can safely be entrusted to the board rather than delegated to the manager, with the comfortable assurance on the part of the latter that, when any such an appointment is to be made, his recommendation will be sought and usually followed.

Scarsdale has had but one manager before the writer, and he died in office after serving 22 years. The same was true of the former street commissioner, who served 25 years. The principal engineer of the village is serving his twenty-seventh year and the village treasurer, his seventeenth. The fire chief has been on the job for 28 years and the chief of police and the superintendent of sanitation pass the 25-year mark in 1949. Franklin Henshaw, the donor to this Association of the Henshaw Cup, retired at the age of 72, after nearly 30 years of village service in various capacities, including about 20 as head of the water department. Civil service tenure played no part in the situation, as that became effective only five years ago.

The salary policy of Scarsdale for many years past has been one to attract and hold competent public officials. Among the department heads and assistants, the principal engineer, his first assistant, the head of the water department and the building inspector are graduate engineers, and the village treasurer is likewise a college graduate.

Water Department Operations

Against this general background, it is obvious that no difficulty is likely to be encountered in carrying on the operations of the water department on a merit basis. Bearing in mind that only if construction exceeds $2,500 in cost must sealed bids be taken after advertising, and that even then the award does not have to go, willy-nilly, to the lowest bidder, it is apparent that the type and quality of works desired are within the control of the head of the water department and the village manager.

The materials of construction can be purchased by the department and furnished to the contractor and only his installation work need be let out to public bidding. To be sure, competition on materials is secured by letter quotations whenever possible, but, if standardization has taken place, the manager need only be assured that he is purchasing at the lowest current price quoted by the purveyor for the quantities involved, before he proceeds to approve water department requisitions for the equipment and materials required. Throughout the 90 miles of mains of the Scarsdale water system, there is but one make of hydrant, one make of valve and one make of meter.

The funds of the water department are kept completely separate from the other funds of the village. The department purchases purified and conditioned water at wholesale, requiring only repumping, elevated storage and distribution facilities, consisting of a plant with an undepreciated cost of only slightly over $1,600,000. The department has, however, a surplus of approximately $125,000 available for extensions and replacements. From time to time, water department surplus cash is loaned to the village. Such transactions are carried on by the issuance of short-term notes, properly authorized by the Board of Trustees, from general operations to the water department, and such notes are promptly paid off at maturity.

The taxpayers of the village pay the water department for fire protection service by the inclusion on their tax bills of a special charge based on the valuation of the property. The current rate is 50¢ per $1,000 of assessed valuation, and, together with charges for similar service to parts of adjoining communities, produces about 18 per cent of the department's total income. With a lawn sprinkling load, late in hot afternoons, that has reached 500 per cent of average consumption, 18 per cent is probably about the proper proportion of revenue for fire service to carry. The equivalent charge in the village is slightly less than $50 per hydrant. Hydrant spacings average approximately 350 ft., the mains include no 4-in. pipe used for fire service and there are no weaks spots in the distribution system in the village which are troubling the fire underwriters. The situation is, of course, simplified by the fact that there are but one minor industrial concern and one apartment building as high as six stories within the village limits and that 99 per cent of the total area has been in parks or zoned for one-family houses for over 26 years.

Departmental Cooperation

The cooperative relationships between the water department and all other departments of a municipality, the necessity for which the author has so well brought out in his paper, result almost automatically under a manager setup like Scarsdale's. Inasmuch as

the activities of all departments, other than routine, clear through the manager—first in the planning stage, then in the stage of procurement of materials, equipment and outside services and finally with regard to the starting date of the various phases of the work—the opportunity for proper coordination is always present.

In Scarsdale, developers of new territory are required to pay the cost of installation of 6-in. water mains throughout the streets they are to build. The water department does the work of installation and bears the expense of the added cost of mains larger than 6 in. in diameter. While a developer is clearing his plans with the planning commission, the procedure which he must follow with reference to water mains—as well as sewers, drains, gas mains from a private utility and the construction of pavement and curbs—is outlined to him and simultaneously it comes to the attention of the manager, who sits with the planning commission as liaison between it, the Board of Trustees and all departments involved.

Schools are not a part of the village government but are operated as a separate municipal corporation. They pay the water department for all extensions required in streets or on their grounds and for all water used. All activities of the schools involving the water department or any other municipal department, other than routine ones, pass through the manager's office for approval and coordination.

Evaluation

Although the method of administration outlined above appears, on its surface, to be somewhat autocratic, in actual operation such is not the fact. There are a number of sizable and active civic and neighborhood associations in the community which have committees assigned to various phases of the municipal administration. These committees function as an active check on the Board of Trustees and the village manager. All major departures from routine are reported upon to the larger of these associations by their committees and are debated in their meetings, following which their recommendations are forwarded to the board or the manager, providing information on the general reactions of the citizens to what is being done or proposed. Such sounding boards of public opinion preserve the ways of democracy at its highest level.

It is admitted that this system of administration, although operating to achieve the best of results when properly used, would not be practical if applied to the political maze that passes, all too often, for municipal government. Likewise, it is obvious that, in large cities, municipal administration cannot be simplified to this extent. Scarsdale, however, offers one illustration of what can be, and is being, accomplished in a limited number of American communities in which water departments operate under the city manager type of administration.

7M.5-T

Tentative

STANDARD SPECIFICATIONS

for

COLD-WATER METERS—CURRENT TYPE PROPELLER DRIVEN

These "Tentative Standard Specifications for Cold-Water Meters—Current Type—Propeller Driven" are based upon the best known experience and are intended for use under normal conditions. They are not designed for unqualified use under all conditions and the advisability of use of the material herein specified for any installation must be subjected to review by the engineer responsible for the installation in the particular locality concerned.

American Water Works Association

Approved as Tentative by the Board of Directors of the A.W.W.A. on July 21, 1949

COPYRIGHTED AS PART OF THE AUGUST 1949 JOURNAL
AMERICAN WATER WORKS ASSOCIATION

First Printing, August 1949

AMERICAN WATER WORKS ASSOCIATION
Incorporated
500 Fifth Avenue, New York 18, N.Y.

Table of Contents

General—Section 5–1

Scope 5–1.1
Kind and Type 5–1.2

Capacity, Size and Length—Section 5–2

Capacity 5–2.1
Size 5–2.2
Length 5–2.3

Design—Section 5–3

Cases or Meter Bodies 5–3.1
External Bolts 5–3.2
Connections 5–3.3
Registers 5–3.4
Register Boxes 5–3.5
Intermediate Gear Trains 5–3.6
Operating Mechanism 5–3.7
Propellers 5–3.8
Seal Wire Holes 5–3.9

Registration—Section 5–4

Pressure Test—Section 5–5

Workmanship and Materials—Section 5–6

Rejected Meters—Section 5–7

NOTES

Tests 1
Testing Equipment 2
Care of Meters 3
Bronze 4
Rubber 5

Committee Personnel

SAMUEL F. NEWKIRK JR., *Chairman*

EDWARD V. BUCHANAN
JAMES G. CARNS JR.
A. P. KURANZ
H. W. NIEMEYER
H. V. PEDERSEN
GEORGE J. ROHAN
GEORGE C. SOPP
L. S. VANCE
W. VICTOR WEIR

Mfrs.' Advisory Com.

R. R. ANDERSON
CHARLES BACHMANN
A. R. WHITTAKER

N.E.W.W.A. Representatives

R. H. ELLIS
W. A. GENTNER
D. H. HALL

Tentative

Standard Specifications for Cold-Water Meters Current Type—Propeller Driven

Section 5–1—General

Sec. 5–1.1—Scope

These specifications embrace the various classes of propeller-driven, cold-water current meters for water works main and branch line (2-in. and larger) service and cover the materials and workmanship employed in their fabrication.

Sec. 5–1.2—Kind and Type

The kinds of meters covered are propeller-driven, main and branch line meters of the current or velocity type. These meters register the flow by recording the revolutions of a propeller which is set in motion by the force of the flowing water coming in contact with the propeller blades.

Section 5–2—Capacity, Size and Length

Sec. 5–2.1—Capacity

Capacity or delivery classification shall be the maximum quantity given in Table 1, Column 3.

Meters shall have a loss of head at maximum capacity not exceeding the value tabulated in Table 1, Column 2.

Sec. 5–2.2—Size

The size of the meter given in Table 1, Column 1, shall be in terms of the nominal size of the opening in the inlet and outlet flanges or the bell-and-spigot ends of the meters.

Sec. 5–2 3—Length

The minimum and maximum overall lengths of the meter, face to face of spuds or flanges—or the laying lengths of bell-and-spigot meters—are given in Table 2, Columns 2 to 7, inclusive. A filler piece can be inserted to increase the length of the shorter meter, if required, but the meter itself must not be shorter than the minimum length given in the table.

Section 5–3—Design

Sec. 5–3.1—Cases or Meter Bodies

The outer case or meter body shall be of cast iron protected by a corrosion-resistant coating, or of bronze or other suitable corrosion-resistant material, and meters shall be equipped with built-in straightening vanes. Casting shall not be repaired, plugged, brazed or "burned in."

All meters shall have the size, serial number and direction of the flow through the meter properly indicated. Meters shall be designed for easy removal of the operating mechanism without disturbing the connections to the pipeline.

Sec. 5–3.2—External Bolts

All external bolts and washers shall be of nonferrous material or protec-

tively treated iron or steel. (All external cap screws or studs shall be of bronze, monel metal or stainless steel.) Nuts shall be of nonferrous material and shall be designed for easy removal after long service.

Sec. 5–3.3—Connections

Meter body connections may be threaded, flanged or bell and spigot, as required. (Threaded connections shall have American Standard internal-taper pipe threads, [ASA 132.1–1941]). Flanges shall be of the round type, faced and drilled, and shall conform to the American Standard cast-iron pipe flange, Class 125 (ASA B16a–1939) for diameter drilling and thickness. Bell-and-spigot connections shall be of cast iron and shall conform to the American Standard cast-iron pit-cast pipe (ASA A21.2–1939), *as far as the specifications apply.*

Sec. 5–3.4—Registers

Registers shall indicate in cubic feet, gallons or other units of measure and shall have at least six number wheels.

The figures on the number wheels shall be large and distinct so that they can be read easily. The register lock and side gears shall be securely fastened to their number wheel discs and hubs. The tumbler pinions shall mesh accurately at the turnover points with the lock and side gears of the adjacent number wheels. Both main and pinion shafts shall be so secured in the register frame that they cannot get out of position. The pinion shaft shall be so designed that there is no possibility of its bending and allowing the pinion to skip at the turnover point. All parts of the register shall be plated or given a protective treatment, or shall be made of material as nearly noncorrosive as possible.

The minimum indication of the digits appearing on the first number wheel, when indicating cubic feet, shall be as given in Table 2, Column 8, and, when indicating gallons, shall be as given in Column 9.

The manufacturer must be able to furnish initial dial indication values

TABLE 1

Propeller-driven Current Meters

1	2	3	4
Meter Size *in.*	Maximum Loss of Head *psi.*	Normal Range of Flow *gpm.*	Maximum Speed of Propeller *revolutions per cu. ft.*
2	1.50	15– 80	75.00
3	1.10	30– 200	35.00
4	1.00	45– 400	22.00
5	0.90	75– 600	15.00
6	0.85	90– 900	6.00
8	0.45	100– 1,200	2.80
10	0.35	125– 1,500	1.80
12	0.25	150– 2,000	1.20
14	0.22	250– 2,500	0.60
16	0.20	275– 3,500	0.40
18	0.19	400– 4,500	0.35
20	0.18	475– 5,500	0.25
24	0.17	700– 8,000	0.10
30	0.16	1,200–12,000	0.07
36	0.15	1,500–16,000	0.05

equal to ten times those listed in Table 2, Columns 8 and 9, when required.

There shall be a test index circle which shall be divided into ten equal parts. The hand or pointer shall taper to a sharp point and shall be accurately set and securely held in place.

Sec. 5–3.5—Register Boxes

Register boxes or bonnets shall be made of cast iron protected by a non-

corrosive treatment, or of bronze composition, aluminum or molded plastic.

Window glasses, if used, shall be inserted from the inside and shall be securely held in place without the use of putty or pins. All register compartments shall be provided with a water escape hole $\frac{1}{8}$ in. in diameter, unless proper provision has been made in the cover below the register bottom plate.

shall fully mesh with each other and shall run freely. Bearings shall be secured so that they will not work out of place and shall be readily replaceable.

Sec. 5–3.7—Operating Mechanism

The operating mechanism from propeller to output shaft shall be easily removable as a complete assembly from the meter body.

Propeller shafts shall revolve in removable, corrosion-proof ball or roller bearings or in bushings of durable material.

TABLE 2

Propeller-driven Current Meters

1	2	3	4	5	6	7	8	9
Meter Size *in.*	Meter Length—*in.*						Minimum Indication of Initial Dial	
	Screw Tube		Flanged Tube		Bell-&-Spigot Tube		*cu.ft.*	*gal.*
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum		
2	11¾	14	13¼	14			1	10
3	11¾	16	12¾	16			1	10
4	11¾	18	13¼	18	21½	21¾	1	10
5	15	20	15¼	20			1	10
6	18	24	22	22	25½	27	10	100
8			24	24	28	32	10	100
10			26	26	30	34	10	100
12			28	28	32	36	10	100
14			39	42	43	50½	100	1,000
16			42	48	46	56	100	1,000
18			45	54	49	62½	100	1,000
20			48	60	52	68	100	1,000
24			54	72	58	80	100	1,000
30			63	84	67	93½	100	1,000
36			72	96	76	105½	100	1,000

Sec. 5–3.6—Intermediate Gear Trains

Intermediate gear trains may be mounted on the measuring chambers or in the upper main casings. Gear train frames, spindles, gears, pinions and bearings shall be made of durable, corrosion-resistant material. Pinions and spur gears shall be firmly fastened,

Sec. 5–3.8—Propellers

The measuring propellers shall be made of suitable molded or cast material. The measuring propeller shall be mounted or shall rotate on phosphor-

bronze or some other suitable metal spindle and shall be supported by jewel, ball or other suitable bearings. Measuring propellers mounted on spindles shall revolve in corrosion-proof ball or roller bearings or in bushing of durable material. The measuring propeller, together with its spindle, shall be, as nearly as practical, of the same specific gravity as water.

The number of propeller revolutions per cubic foot should not exceed the quantities given in Table 1, Column 4.

Sec. 5–3.9—Seal Wire Holes

Register box screws shall be drilled for seal wire holes. All seal wire holes shall be not less than $\frac{3}{32}$ in. in diameter.

Section 5–4—Registration

The registration on the meter dial shall indicate the quantity recorded to be not less than 98 per cent nor more than 102 per cent of the water actually passed through the meter while it is being tested at any rate of flow within the limits specified in Table 1, Column 3, under "Normal Range of Flow."

Section 5–5—Pressure Test

Meters shall be guaranteed to operate under a working pressure of 150 psi. without leakage or damage to any part.

Section 5–6—Workmanship and Materials

Meters shall be guaranteed against defects in materials and workmanship for a period of one year from the date of shipment. Parts to replace those in which a defect has developed within such period shall be supplied without charge, piece for piece, upon the return of such defective parts to the manufacturer thereof or upon proper proof of such defect.

Section 5–7—Rejected Meters

The manufacturer shall, at his own expense, replace or satisfactorily readjust all meters rejected for failure to comply with these specifications.

NOTES

These notes are not part of the specifications. They are given only as information concerning the testing and care of meters and important materials used in meter construction. They are not intended to limit in any way the future development of better materials for general use or the use of special metals with specific waters which may require materials of different composition to give service equal to that recorded in normal practice.

(1) *Tests*

Capacity tests are those which test the design of the meter. When a meter of a given design has once been tested for capacity, it should not be necessary to test this type of meter again unless a change has been made in the design.

Registration tests are those which test the assembly and workmanship of the meter. Each meter should be tested for registration, as there is no assurance that, because one meter of a given design is within certain limits of accuracy, all meters of this design will necessarily give similar results. The register furnished

with each meter should be used by both the manufacturer and the purchaser in making registration tests.

All meters should be tested for accuracy of registration within, and as near as practicable to, the low and high rates given under Table 1, Column 3, "Normal Range of Flow," and occasionally additional tests should be made at one or more intermediate points.

A pressure test should be made on each size of meter of a particular design furnished. The pressure is to be 150 psi., and may be obtained by the use of a hand pump or any other method available. The meter should be tested for accuracy before and after it has been tested by static pressure, to determine whether there has been any distortion that would affect the registration. It is unnecessary to make more than one pressure test on each size of a given design if satisfactory results are obtained. A working-pressure test is preferable to a static-pressure test.

If the purchaser has no testing equipment, a certificate should be furnished by the manufacturer showing that each meter has been tested for accuracy of registration, that it complies with the specifications and that the size and design meet with the capacity requirements.

(2) *Testing Equipment*

Typical test equipment includes:

(a) A valve on the supply line which would permit the starting and stopping of the flow without appreciable loss of time. This valve should be wide open during test.

(b) A valve or other suitable device on the discharge line which can provide the rate of flow desired.

(c) Pressure gages on supply and discharge pipes, so that any change in pressure which would affect the rate of flow can be detected. The discharge pipe must be under sufficient head to guarantee a pressure on the outlet of the meter.

(d) A measuring device of either the volumetric or weighing type. The accuracy of the determination of the amount of water discharged should be such as to bring the limit of error within 0.25 per cent. The amount of water passed should be sufficient to cause at least one revolution of the pointer on the initial dial except for the test at the minimum flow rate. The amount passed at this rate should be of sufficient quantity to secure a true indication of the accuracy.

(e) A differential mercury manometer (or inverted water manometer with an adjustable scale for precision reading in capacity tests). The inlet connection to the manometer should be made at a point about one-half a pipe diameter ahead of the inlet edge of the meter body, and the outlet connection about two pipe diameters beyond the outlet edge of the meter body. These connections should be at right angles to the axis of the pipe and should be filed or ground off until they are smooth and flush with the inside surface of the pipe; they should be free from any burrs. The size of the connections should not exceed $\frac{1}{4}$ in. for 2- or 3-in. meters; $\frac{3}{8}$ in. for 4-, 5- and 6-in. meters; and $\frac{1}{2}$ in. for 8-in. and larger meters. The taps are connected to the manometer by rubber or metallic tubing. Provision is to be made for the complete removal of air from the manometer and the tubing connected therewith, and the installation is to be such that air will rise to the air outlets. For accurate observations it is necessary to read both sides of the mercury column simultaneously in order to compensate for irregularities in the diameter of the manometer tubes and to avoid errors due to fluctuations.

(3) *Care of Meters*

In this type of current meter the motion of the propeller is transmitted by a system of gearing to the register, where the flow is recorded in convenient units of measure, such as cubic feet or gallons. The gearing serves to translate the motion of the propeller into the unit of measure indicated by the register. The register is at all times a measure of the number of revolutions of the measuring

propeller in terms of cubic feet or gallons. It records a true measure of flow only when the meter has been properly calibrated by gear adjustment, and after proper calibration will continue to register correctly only as long as the propeller continues to make the proper number of cycles for each unit of quantity passed through the meter. If, after calibration, any condition should develop whereby the propeller is compelled to make less than the proper number of cycles per unit of quantity passed through it, the meter will underregister. If the propeller is compelled to make more than the proper number of cycles, the meter will overregister. The proper number of cycles is the number made at the time the meter is calibrated.

Meters may be installed in horizontal, vertical or slanting pipelines. Both the piping on the inlet side of the meter and the meter itself must run absolutely full of water at all times. The register may face upward or sideways, but not downward without a special arrangement to prevent flooding of the register and register box or bonnet by accidental leakage through the stuffing gland.

Under ordinary working conditions, there are a number of factors that may cause under- or overregistration after comparatively short intervals. The more important of these factors, which should be guarded against to secure proper registration, are:

(a) *Excessive wear.* Excessive wear of the moving parts of the meter may be caused by improper setting, by overspeeding, or, in general, by the selection of a meter too small for the work required. The effect of excessive wear of the propeller or measuring chamber is slippage and underregistration. Excessive wear of the intermediate gear train may cause binding of the gears or gear slippage. In any case, if the meter is not stopped entirely, underregistration will result. To avoid excessive wear, meters should not be run at destructive speeds. The capacity of the meters given in the specifications is for continuous 24-hour service. The maximum rate of flow which should be passed through the meters for very short periods of time or the peak loads which should come upon meters only at long intervals should never exceed twice the tabulated values.

(b) *Temperatures.* High temperatures may cause distortion of the propeller blades, bearing troubles and so on. The result will be incorrect registration or failure of the meter. Low temperatures, above 32°F., have no noticeable effect on the working parts of the meter. Freezing will stop the meter and possibly damage it.

Cold-water meters are not affected by temperatures up to about 80°F. If this temperature may be exceeded, the manufacturer should be consulted with respect to special provisions for the higher temperature and the resultant effect on accuracy and capacity.

To avoid troubles caused by temperature, meters should be set at locations where they will be protected from heat and frost. At locations where hot water from heating systems may be forced back through the meter, a check valve and pressure and temperature relief valve should be installed on the outlet side of the meter, if the manufacturer requires it.

(c) *Corrosion.* The metals used in the construction of a meter may be affected by the corrosive action of water. The action is very slow with most potable waters. The result is that parts of the meter are weakened, particularly the teeth of the open intermediate gears, and, in meters that are idle for long intervals, there is a tendency toward binding. Tuberculation of the outer case in meters of the current type may change the normal direction of flow and cause overregistration.

(d) *Material in suspension.* Foreign material carried in suspension may be deposited, and accumulations of deposit always tend to cause overregistration, as any conditions tending to change the velocity of flow, after the meter has been

calibrated, will cause overregistration. Such overregistration is not limited.

Meters provided with strainers will retain the larger particles of material in suspension, but the strainer will soon become clogged if the water is not kept reasonably free of suspended matter. Sand is especially destructive and care should be exercised to keep sand from reaching the pipes supplying the meters.

Because the finer particles of suspended material cannot be prevented from reaching the meter, troubles from this source can be avoided only by cleaning the meter periodically, the interval between cleanings depending upon the quality of the water.

(e) *Periodic tests.* Meters properly selected as to size and type will give satisfactory service over a long period without attention only when operated under ideal conditions. Under ordinary conditions, meters must be given some care if they are to function properly. Usually it is impossible to ascertain, without an actual test, whether a meter which has been in service is registering within the required degree of accuracy. Consequently, to insure reliable meter measurements, it is essential that all meters be subjected to periodic tests. The interval between tests and the method of conducting them must be governed largely by local conditions. Under *average* conditions, the meters should be overhauled and checked at least once every two years. Observations made during the first year of operation will determine how often the approach and propeller sections of the waterway must be cleaned of incrustations to prevent overregistration.

Many state regulatory commissions specify the intervals between the tests on both a time and quantity basis.

Meters of the current type, used for measuring unfiltered surface waters, should be cleaned about once a year, in order that they may be kept in good working condition. When filtered or exceptionally clean water is used, the interval between cleanings may be longer.

The best results will be obtained from current meters if they are calibrated in place, since the accuracy of the meter may be affected by changes in the distribution of velocities approaching the meter. A meter of this type, calibrated where there is a straight run of pipe and no swirling flow on the inlet side of the meter, may register incorrectly from the start if installed where there is a bend, valve or any piping arrangement producing helical motion in the flow near the inlet side. Straightening vanes built into the meters appreciably reduce errors due to helical flow or other disturbances. Any other conditions tending to change the distribution of velocities existing at the time of calibration may affect the accuracy of the meter. If calibrated on the premises, this source of error is minimized.

Following the manufacturer's recommendation is the best way to produce an installation which will minimize the probability of affecting the accuracy of the meter as determined by laboratory test.

For 3-in. and larger meters the installation of a test tee in the outlet piping makes testing easier and reduces the cost of testing on the premises.

(4) *Bronze*

A bronze satisfactory for most water is that of A.S.T.M. Specifications B62–36 or No. 2 Federal Specifications QQ–B–691a for an alloy of copper, tin, lead and zinc, known commercially as composition metal, 85–5–5–5, ounce metal, red brass or hydraulic bronze.

(5) *Rubber*

A satisfactory rubber for propellers and bushings should, among other items, have a specific gravity under 1.2, a minimum tensile strength of 6,500 psi., a maximum elongation of 5 per cent, a hardness (scleroscope test) of not less than 67, a free-sulfur content of 3 per cent or less, a free-ash content of not more than 3 per cent and a uniformity of cure and physical characteristics.

Section Award Policy

Committee Report

A report presented by the General Policy Committee to the Board of Directors of the A.W.W.A. on June 3, 1949, and approved by the Board on that date.

IN its discussion of various proposed awards, several of which involved length of service or length of membership in either a Section or the A.W.W.A., the General Policy Committee considered certain basic questions. In considering these questions the committee had in mind the fact that the A.W.W.A. is primarily a professional and technical association, whose awards have always been highly prized by their recipients; and it is to insure the maintenance of this high award standard within its proper sphere that the numbered points below are listed for consideration by, and the guidance of, those who have the responsibility either for initiating or conferring the awards.

1. Long service in the water works industry, of itself, may be the basis for the individual company, municipality or state to acknowledge the service of a long-time employee.

2. Long service in the water works industry, of itself, is not sufficient basis for the granting of A.W.W.A. or Sectional awards.

3. Neither the A.W.W.A. nor its Sections should seek to perform the function of the employer in Point 1, above, where long service is the principal reason for recognition.

4. Long-term membership in the Association is a proper subject of recognition for the various Sections to accord their members.

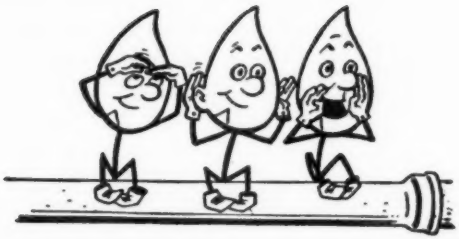
5. If Sections find it desirable to recognize long-term service by an individual to his community coupled with his membership in the Association, it would tend to increase the value of the action if some minimum term of membership were agreed upon as the basis for such recognition. The minimum term should be not less than ten years.

6. It is the committee's opinion that the word "Award" should be reserved for honors involving service or a contribution on the part of the member, and a differing designation (for example, "Citation") used to describe those honors having to do largely with tenure.

7. Outstanding achievement in the water works field is, of course, a proper basis for an award by the A.W.W.A. or a Section at any time, regardless of length of service or length of membership.

8. "Outstanding achievement" is a relative term; and to the extent that increasing numbers of annual awards become available, the quality of the service and the value of the award tend to depreciate.

In setting down the above points, the committee is attempting to fulfill what it considers to be its larger responsibility in the matter of awards—the establishment of certain broad criteria which will serve to guide the Association and its Sections, so that at all times uniform principles may be applied to the establishment of awards and their too rapid growth limited. This committee does not wish in any way to restrict the freedom of action of any of the Sections but feels that it is the only existing body charged with placing this problem in overall perspective.



Percolation and Runoff

Heat may seem a strange thing to solicit in these sunbaked ovenues of New York, but heat is what we're after. Not, however, the unprecedented meteorological stuff that virtually aridified the Northeast during June and July, but the heat of an almost cataclysmic controversy.

On page 36 appears evidence that two JOURNAL readers object to its pictorial cover. Previous correspondence has revealed that two readers favor it. Now, obviously, a tie vote among 0.05 per cent of our readers represents something less than a clear mandate for action. Thus, what we need in planning a 1950 cover is at least some clue to the opinions of the mum 99.95 per cent.

We might report that an informal survey in the Houston Water Dept. by reader Aldrich revealed an even division among "like," "dislike," and "no opinion," but what we want now is some "love," "hate," and, perhaps, "what cover?" correspondence. So dip your pen in vitriol or rose water and give us the WORD!

Meanwhile, heat of the noncontroversial variety has decended upon us in overcoming profusion, unasked and unwanted. Yet it hasn't been the heat, but the aridity which has made the unhappiest news here in the Northeast. With every rainless day adding misery and loss to an already record drought and record drought toll, the heat wave has washed even the cold war out of the headlines.

To date (July 6) it has been the farmer who has borne the brunt of the torridity. In New Jersey alone, crop losses reached an estimated $30,000,000, with every new day of drought adding some $500,000 to that total. On Long Island and in southern New England, too, disaster has threatened. But it will not be long until the farmers' sufferings are translated into higher food prices throughout the area.

To the moment, water supplies happily have been able to withstand the shock in pretty good shape. Yet, with new consumption records being

(Continued on page 2)

(*Continued from page 1*)

set almost daily, it will not be long, either, until present conservation pleas will yield to active restrictive measures. Reporting a rise to approximately 1.4 bil.gal. per day consumption, New York City water commissioner Carney has indicated that the drop of 33 bil.gal. in reservoir storage during the month of June was considered "not safe," although not yet "hazardous." Out in Orange, N.J., water department employees are making "face to face" appeals to consumers to aid in water conservation by not sprinkling lawns or washing cars. Livingston, N.J., has already reached the stage of "prohibiting" lawn sprinkling between 4 and 9 P.M., levying a fine of $25 for each violation. And up in Montreal, last month, worried residents swamped police headquarters with some 200 telephone calls per hour reporting water waste by their neighbors. Similar appeals and demands for cooperation in conservation have been instituted pretty generally throughout the stricken area, but in no case has there yet been reported an actual rationing of necessary supplies.

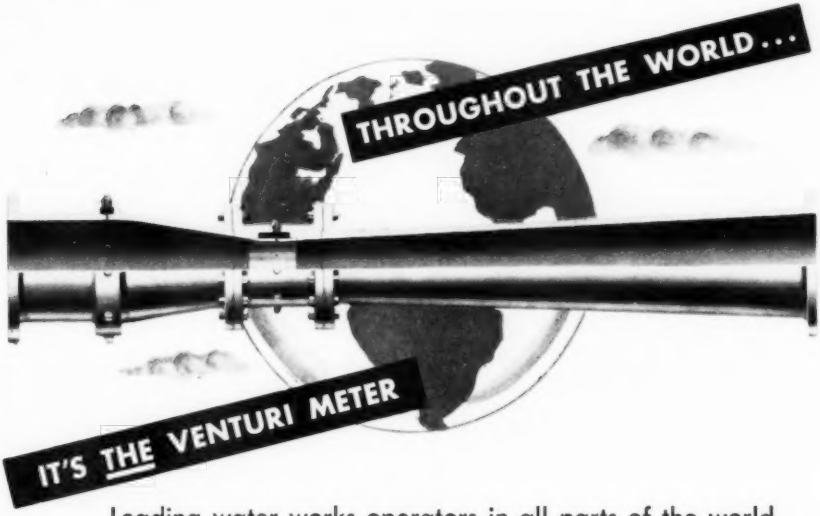
About the only thing that hasn't dried up in the current excess of desiccation is the wellspring of humor that keeps us laughing at ourselves. And if the laughter is often a little rueful, that makes it none the less a relief in an otherwise monotony of curses and complaints.

In mid-June, for instance, when the drought was a mere 25 days old, came a report from the Green Cow Ice Cream Co. of Newark, N.J., that parched pilferers had made off with $10 worth of ice cream and a quantity of dry ice. And on the same day, in Florence, N.J., a popular science farmer ground up 500 undoubtedly different pounds of dry ice, loaded them into a plane and made a successful bombardment of a huge cumulus cloud only to find that the five-minute downpour which followed missed his own acreage by a country mile.

Then at June's end the Newark airport weather bureau submitted a classified advertisement offering its rain-measuring bucket for sale "cheap," indicating that it was "good as new," having measured only 0.07 in. of rain during the month. And, rating front-page headlines, was a review of traditional sure-cures for drought dispelling, which discussed the efficacy of the old Armenian custom of dunking the parson's wife, of starting forest fires or even battles, because heavy rains "always" follow, and of Indian dancing and imprecation-uttering.

Not foolish enough to suppose that this foolishness was of great help to the heat- and drought-stricken, we are yet convinced that the newspapers who subscribed to it were much more humane than those who relied on headlining other people's floods and snowstorms. Contemporarily, it is true, the Southeast was wallowing in an overabundance of water and skiing was the order of the day on Oregon's Mt. Hood and Washington's Olympic range, but why rub it in? If it ain't gonna rain no more, no more, at least our vacation won't be another washout.

(*Continued on page 4*)



Leading water works operators in all parts of the world consider Builders Venturi Meter vital to efficient operation. The Herschel Standard Venturi Tube for two generations has been "Standard Practice" in the measurement of flow.

- **Enduring Accuracy:** calibration tests prove built-in metering accuracy within 1%
- **Low Head Loss:** reduces pumping costs
- **No Moving Parts:** simple, solid construction
- **Long Life:** no tube has ever worn out
- **No Mechanism in the Line:** clear passage-way through tube
- **Self-cleaning:** Venturi throat greatly accelerates flow rate
- **Capacities easily changed:** throat sections interchangeable

A complete line of Builders instruments is available for totalizing, indicating, and recording flow with the Venturi Tube. For Bulletins address Builders-Providence, Inc., (Division of Builders Iron Foundry), Providence 1, R. I.

BUILDERS PROVIDENCE
Instruments

(*Continued from page 2*)

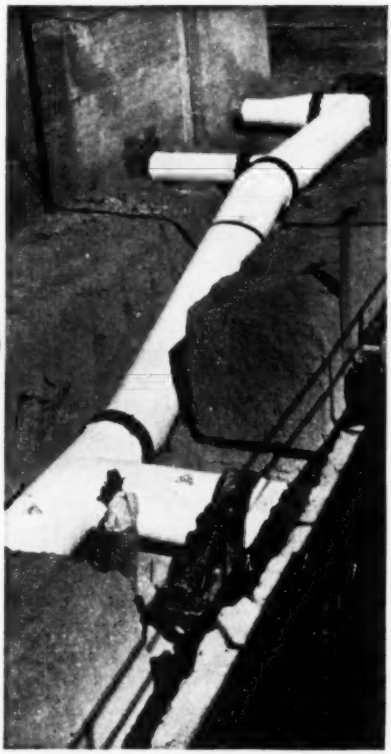
Our drought, however, has been apparently as nothing compared with the contemporary drydom of Britain. There, the lack of precipitation had in early July already forced a reimposition of milk rationing and was threatening root crops with blight. With the flow of the Thames over Teddington dam reduced from 596 mgd. to a mere 245 mgd., London's metropolitan water board had already banned the use of water for gardens and was worrying about its drinking supply. But it was in Wales that the drought undoubtedly reached its peak, for on the Welsh island of Anglesey, country inns had begun featuring a sign which said: "No Water, Please Take Soda With Your Whiskey." By now they're probably drinking it straight—neat, that is.

The "Fireman Save My Child" drama was enacted in an unusual way out in Central Islip, Long Island, last month when a main break left the community without water for a whole day. Answering appeals from formula-mixing mothers, firemen tapped their live hydrants and delivered bottles of the baby brew to the homes of parched infants. Just what effect this early imbibition of fire water will have on the young topers is not easy to imagine, but the flame of their immediate discontent at least was extinguished.

Speaking of benign beverages, though, we must not fail to cite the effluent of the Sea Bright, N.J., sewage treatment plant. In a dramatic response to a state health department complaint that his plant was polluting the ocean off Sea Bright, Supt. John D. Watkins quaffed a glass of his plant product while newspaper photographers and reporters observed but declined to participate. Admitting that the treated sewage wasn't as tasty as a cold glass of beer, or drinking water for that matter, he claimed it was just as safe to drink. Thus, deleting the "late" in their stories of the histrionic Mr. Watkins, reporters were forced to admit that the ocean potion couldn't be too bad.

(*Continued on page 6*)

THIS STEEL PIPE
cuts water supply costs



Many waterworks men have found they get improved operating efficiency by using ARMCO Welded Steel Pipe for water supply and force mains.

There is little or no loss from leakage. Strong, tight joints can be made with standard couplings or by field welding. A smooth, spun-enamel lining prevents tuberculation and assures continued high flow capacity.

ARMCO Steel Pipe also has a high strength-to-weight ratio that withstands internal or external pressures. It flexes with the load to guard against explosive bursting due to vibration or sudden overload.

You'll find ARMCO Pipe easy to handle and install. Jobs go fast and costs are low. Diameters of ARMCO Steel Pipe range from 6 to 36 inches with wall thicknesses from 9/64- to 1/2-inch. Write for complete information. Armco Drainage & Metal Products, Inc., 1575 Curtis Street, Middletown, Ohio.

ARMCO

ARMCO WELDED STEEL PIPE

MEETS A. W. W. A. SPECIFICATIONS

(*Continued from page 4*)

Ernest B. Black, partner in the Kansas City consulting firm of Black and Veatch, died on July 4 at the age of 67 after having been in ill health for four years. He had been confined to his home since last September, when he suffered the first of a series of heart attacks. A graduate of the University of Kansas in 1906, he had worked as an assistant to his father, a surveyor, and as a masonry inspector for a railroad previously. His first professional association was with a Toledo engineering firm, and in 1909 he came to Kansas City where he joined the firm of J. S. Worley, later known as Worley & Black and, in 1915, as Black and Veatch. During World War I he was responsible for the utility construction at Camp Pike, Ark., and later became evaluation engineer for the War Credits Board. In World War II he became head of the water engineering branch of the Quartermaster Corps, supervising water supplies at all army camps. His investigations and engineering activities had justly earned him a reputation that was nationwide.

It is understood that the firm of Black and Veatch will continue under the same name and with no changes in policy or personnel.

Linwood G. Mort, partner in the consulting firm of Argraves and Mort, New Haven, Conn., died on July 4 at his home in Guilford, Conn. The firm will continue as Newman E. Argraves and Assoc.

Harald M. Olson, consulting maintenance engineer for the Morton Salt Co., died on June 27 at his home in Mt. Lebanon, Pa. An author of several widely distributed papers on the advantages of water softening, he had until recently been manager of the water softening division of the Ohio Salt Co.

A roster of sanitary and public health engineers is being prepared by the American Public Health Assn. in cooperation with the National Security Resources Board. The primary interest of the latter agency is in having a list that will facilitate the proper utilization of engineering manpower in times of national emergency, but of course the list will have many uses. It is intended that all qualified engineers who are U.S. citizens be included in the list. Any who have not received the questionnaire, therefore, are requested to communicate directly with the Engineering Section Project, American Public Health Assn., 1790 Broadway, New York, N.Y.

Joseph F. O'Grady has been appointed assistant sales manager of the Pittsburgh Equitable Meter Div., Rockwell Mfg. Co. He had been supervisor of water meter sales in the Pittsburgh district for the past two years, and previously was connected with headquarter sales in Pittsburgh.

(*Continued on page 8*)

WORTHINGTON-GAMON

WATCH DOG

The meter used by thousands of municipalities in the U. S.

WATER METERS

"Watch Dog" models . . . made in standard capacities from 20 g.p.m. up: frost-proof and split case in household sizes. Disc, turbine, or compound type.

SURE TO MEET YOUR SPECIFICATIONS FOR ACCURACY, LOW MAINTENANCE, LONG LIFE.

Before you invest in water meters, get acquainted with the design and performance advantages which make Worthington-Gamon Watch Dog Water Meters first choice of so many municipalities and private water companies in the United States.

WORTHINGTON-GAMON METER CO.

296 South Street, Newark 5, New Jersey

SUBSIDIARY OF

WORTHINGTON

WORTHINGTON PUMP AND MACHINERY CORPORATION

(*Continued from page 6*)

Campus commencements last June brought deserved honors to two A.W.W.A. members:

Charles P. Hoover was awarded an Honorary Doctor of Engineering degree by Ohio State Univ. at commencement exercises on June 10. A graduate of that institution, class of 1908, Hoover received the honor for his research in water purification and the improvement of municipal water quality during his 40 years of service with the Columbus Div. of Water.

Francis S. Friel, consulting engineer, was awarded an honorary Doctor of Engineering degree by Drexel Inst. of Technology, Philadelphia, on June 20. The citation referred to his work on over 350 major engineering projects over the past 25 years, including the design and construction of water systems for Chester, Pa., and Winston-Salem, N.C., and the contributions they constitute to the "arts of organizing metropolitan communities for healthful living."

Gerald A. Fleet has been appointed district manager of the metropolitan New York area for American Well Works of Aurora, Ill. His headquarters will be at 475 Fifth Ave., New York 17.

(*Continued on page 10*)

CARSON CLAMPS
Stop Joint Leakage
Write for information
CARSON-CADILLAC COMPANY
1221 Pinson Street
Birmingham, Alabama

PROOF
OF
"STERELATOR EFFICIENCY"

NO JOB TOO LARGE

SEND US COPY OF SPECIFICATIONS

Actual Users—THE BEST PROOF OF ALL—
Prove our claims that Everson SterElatorS are
DEPENDABLE · SAFE · EFFICIENT
Easy to operate at LOW MAINTENANCE COST.

Everson SterElatorS METER-MIX-FEED Chlorine accurately for all water SterElixinG requirements. Furnished for manual or automatic operation.

Everson SterElatorS utilize a high vacuum. The indicating FLOW METERS have a 10 to 1 ratio. Send for list of installations.

SterElatorS by Everson

EVERSON MANUFACTURING CORPORATION
221 West Huron Street, Chicago 10, Illinois

GENERAL CHEMICAL "ALUM"

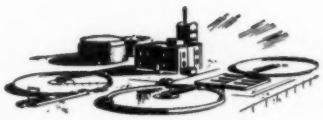
...Equally Efficient for Coagulation of WATER and SEWAGE!

FOR WATER WORKS

1. Produces crystal clear water.
2. Gives better floc formation.
3. Promotes better settling and longer filter runs.
4. Aids in reduction of tastes and odors.
5. Has no chlorine demand.
6. Is a *low cost* coagulant.
7. Superior in tests against other coagulants.
8. High in quality. Its constant uniformity can be depended upon.

Aluminum Sulfate is almost universally accepted by water experts as the best coagulant for removal of turbidity, color and bacteria from water . . . and General Chemical Aluminum Sulfate is the outstanding choice the nation over. That's because its high quality and constant uniformity have given it a time-tested reputation for reliability among operating men in towns and cities all over America.

Municipal officials in charge of sewage treatment also find that clarity of sewage effluent is easily obtainable with General Chemical Aluminum Sulfate for the many reasons outlined **above**. For your water and sewage disposal systems, specify General Chemical "Alum"—*preferred by most American cities.*



FOR SEWAGE PLANTS

1. Clean, easy to handle.
2. Dry feeds well or dissolves readily for solution feeding.
3. Simple application. Requires only low cost feeding apparatus and minimum attention.
4. Clear, colorless effluents are possible.
5. Sludge digests readily.
6. Treated digested sludge dries quickly with minimum of odor.
7. Chlorine consumption is cut due to lower demand of clarified sewage.
8. Economical to use.

GENERAL CHEMICAL DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

Offices: Albany • Atlanta • Baltimore • Birmingham • Boston Bridgeport • Buffalo • Charlotte • Chicago • Cleveland • Denver Detroit • Houston • Kansas City • Los Angeles • Minneapolis New York • Philadelphia • Pittsburgh • Portland (Ore.) Providence • San Francisco • Seattle • St. Louis • Wenatchee Yakima (Wash.)

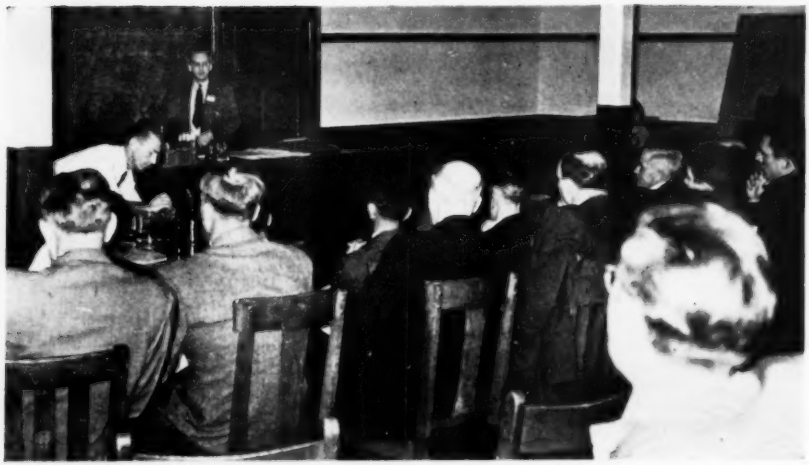
In Wisconsin: General Chemical Company, Inc., Milwaukee Wis.

In Canada: The Nichols Chemical Company, Limited
Montreal • Toronto • Vancouver

BASIC CHEMICALS

FOR AMERICAN INDUSTRY

(Continued from page 8)



Lecture and demonstration on water quality by Harold Millikin and Harold Merryman, sanitary engineers with the Oregon Board of Health, captures attention of class during Water Works Operator's Short Course at Oregon State College, March 21–24. Discernible to the right of the pillar is Walter J. Moore, Section Director and superintendent of the Eugene, Ore., Water Board.

One up on Ben Franklin is Edgar Ohlsen of Ogden, Iowa. More than understanding lightning, Ohlsen can evidently outguess it. At any rate, when a bolt struck his home last June, he had a chemical fire extinguisher there waiting. The lightning struck the extinguisher, released the contents and thereby smothered its own flame. Premeditated water conservation if we ever saw it.

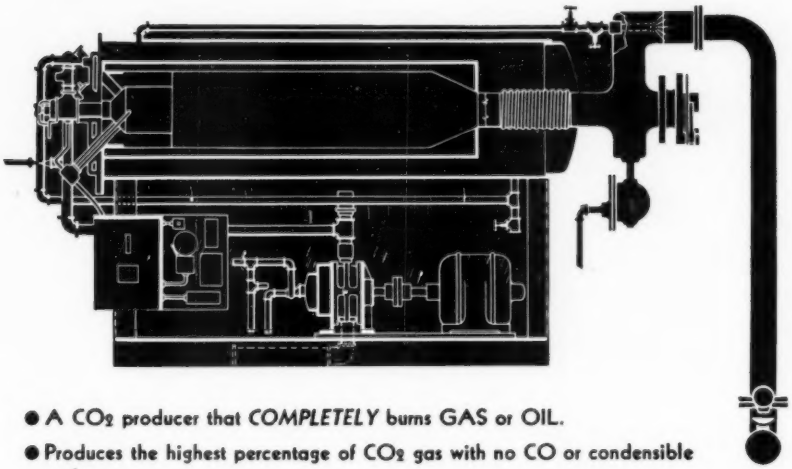
A perfect, if unintentional, recipe for fish was issued by the San Diego County Health Dept. last month when an electric fish screen at the San Jacinto Reservoir failed and flooded certain areas of the distribution system with a fine catch of "fingerlings," delivered, without additional charge, through consumers' faucets in the outlying sections of the service area. Officials recommended that housewives boil the water containing the fish, strain the fish off, throw the fish away and then drink the water. Not since the famous formula for baking catfish in Mississippi mud have we found a seafood concoction more to our taste. As a matter of fact, we ourselves would supplement the instructions by suggesting an activated carbon strainer, but that would undoubtedly be gilding the lily. And, by the way, the situation itself was viewed by the health department as "not alarming," with the prediction that it would be cleared up in a few days.

(Continued on page 12)

CARBALL CO_{TWO} UNIT...

SPECIFICALLY DESIGNED FOR THE CLEAN, EFFICIENT CARBONATION OF LIQUIDS

93% ABSORPTION – 88% TOTAL CHEMICAL EFFICIENCY



- A CO_2 producer that *COMPLETELY* burns GAS or OIL.
- Produces the highest percentage of CO_2 gas with no CO or condensible carbon.
- Completely eliminates oil scum . . . no taste imparted to potable waters.
- No scrubbers or filters required.
- Compressor handles clean, cold air only. The fuel is burned under sufficient pressure to cause deep diffusion directly from the producer.
- Diffuses CO_2 gas by efficient impingement diffuser, insuring 93% absorption and eliminating diffuser corrosion.
- A factory-tested, package unit with air compressor, fuel pumps and appurtenances mounted on one frame.
- 50% more chemical efficiency than any other method in current practice.

To Reduce Costs and Modernize Your Plant:

WRITE FOR BULLETIN 757

WALKER PROCESS EQUIPMENT INC.

EQUIPMENT • EQUIPMENT ENGINEERING

PROQUIP **AURORA • ILLINOIS**

(Continued from page 10)

Thorndike Saville, dean of the New York Univ. College of Engineering, has been elected President of the American Society for Engineering Education.

The D'Amico Plan may be only a drop in the bucket compared with the mammoth Marshall Plan, but it is a drop of water and that's what counts with us. Thus we're voting Joseph D'Amico, Atlantic City, N.J., merchant who fathered the idea, our favorite philanthropist.

The "plan" involves providing some $20,000 in funds to the Italian village of Santa Croce di Magliano, with which the villagers, who have already pledged labor and tools, are going to build their first public water supply system. That D'Amico's basic interest in the village stems from the fact that he was born there does not reduce one whit the praiseworthiness of the plan, nor does it dim our pleasure at the soundness of his judgment in picking a worthy subject for philanthropy. It is thus a pleasure, too, to report that, as of our latest report, contributions toward the project had reached a point which seemed to assure residents of the mountain village its own water supply before the end of 1949, after hundreds of years of private water scrounging.

(Continued on page 14)

- Saves 75% of costs
- Goes 4 times as far
- Eliminates caulking
- Needs no large bell holes
- Self-seals if broken

Immediate shipment. FREE: Illustrated catalog.

Producers also of M. H. Brand Caulking Lead

MICHAEL HAYMAN & CO., INC.
Est 1869
862 East Ferry St. Buffalo 11, N. Y.

for

WATER WORKS ECONOMY

Master meters on vital main-lines are the keys to water works efficiency and economy. How easy it is—and inexpensive—to install

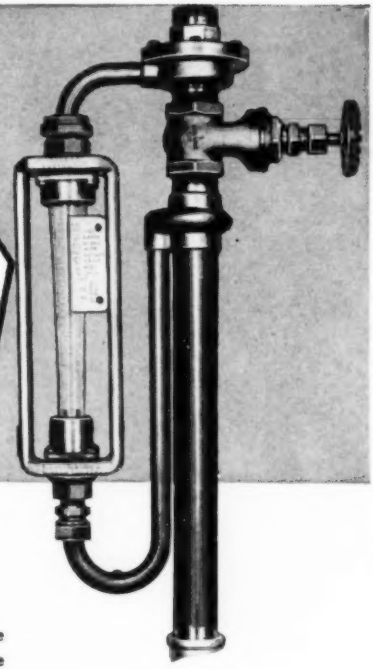
SPARLING
Main-Line Meters

They tell you just what is going on! Accuracy within 2 per cent is guaranteed. For full information, prices, etc., see Bulletin 310—mailed to you on request.

The SPARLING Manufacturer of WATER METERING EQUIPMENT

LOS ANGELES 54 . . . . Box 3277, Terminal Annex
CHICAGO 8 . . . . . 1500 South Western
CINCINNATI 2 . . . . . 622 Broadway
NEW YORK 17 . . . . . 101 Park Avenue
BOSTON 8 . . . . . 6 Beacon Street
SEATTLE 1 . . . . . 1932 First Avenue
DALLAS 1 . . . . . 726 Reserve Loan Life Bldg.

New FORD Testerate Indicator has wide range



Now, for the first time you may measure both small and large test flows on the same indicator, and with close accuracy.

The new Ford Double Range Testerate Indicator checks the flow of a test stream at a glance, down to as low as ¼ g.p.m. and up as high as 175 g.p.m.

Operation is easy. On flows over 35 g.p.m., merely open by-pass valve wide and take reading on high range scale.

The Double Range Testerate Indicator is adequate for all sizes of meters up to 2" and even larger.

Send for complete information and new catalog.

The **TESTERATE** INDICATOR

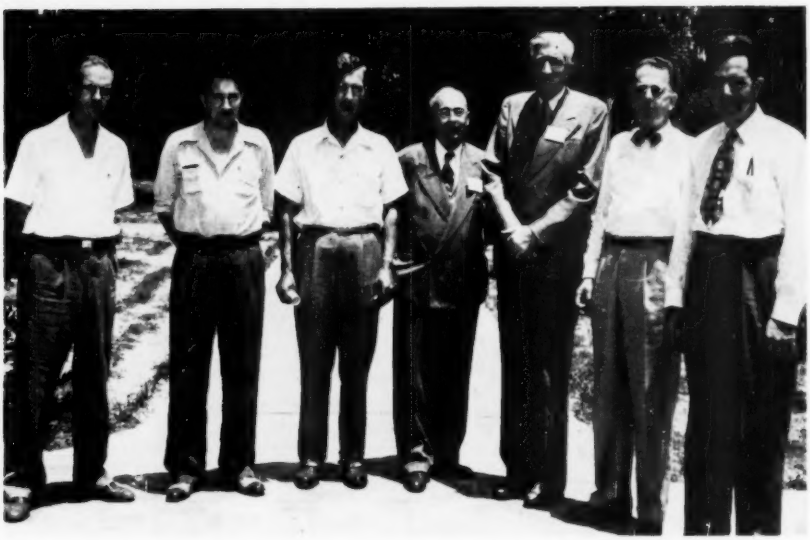
FOR BETTER WATER SERVICES

FORD

Manufactured by THE FORD METER BOX COMPANY, INC.

Wabash, Indiana

(Continued from page 12)



Helping to make a success of the 17th annual short course, held at the Univ. of Florida June 6 to 11, for 160 students, are Clifford D. Williams, head of the university's civil engineering department; Charles Fiske of the Florida Water and Sewage Works Operators Assn.; J. R. Hoy of the Florida Sewage Works Assn.; V. M. Ehlers, F.S.W.A. President; A. P. Black, A.W.W.A. President and head of the university's chemistry department; John B. Miller, engineer for the State Board of Health; and G. M. Turner, assistant dean of the university's general extension division.

Cliff Fore's practically perfect prognostication of Chicago Conference registration—his 1,972 compared with its 1,967—made him not only a prophet, but a profit, with not only honor, but an honorarium, in his own Illinois Section. At any rate the traditional Director's pool of forty-four crisp greenbacks, collected at Chicago last January and fondled in New York since then, has returned to Illinois.

Anxious to learn what Mrs. Fore was planning to do with the money, we penned a hasty inquiry to her predictful husband and were astonished to learn that, even after admitting his pot loot, he managed to apply it to his own ends. Thus, together with some other funds which he wouldn't admit saving from his lunch money, the pool cash will go to make District Manager Fore, Movie Cameraman Fore. From now on, in our books, however, he'll always be ForeMAN!

Grant E. Scott Jr. has been appointed assistant sales manager of Klipfel Valves, Inc., division of Hamilton-Thomas Corp.

(Continued on page 16)

Teddy Roosevelt was president when we cleaned Washington's mains in 1907
1945 — National begins a 5 year job
Cleaning controlled by 2 way radio
NATIONAL CLE NG AGAIN
owers pumping costs
increases volume
increases water pressure
FOR WASHINGTON, D C
Before cleaning
After cleaning

Way back in 1907 and again in 1926 National successfully cleaned the water mains of Washington, D. C.

In 1945 a five year program to clean and recondition the entire water main system of Washington was begun and National in conjunction with the Centriline Corporation was again awarded the cleaning contract for 1945, 1946, 1947, 1948 and 1949 — *in short, the entire cleaning job!*

Tests made on those lines already cleaned and centrilined indicate a co-efficient of over 130 as against less than 90 before cleaning, resulting in lower pumping costs, increased volume and higher pressure.

Let us estimate the cost of restoring your lines to at least 95% of their original carrying capacity. Write today.

NATIONAL WATER MAIN CLEANING COMPANY

29

50 Church Street, New York 7, N.Y.

ATLANTA, GA., 333 Candler Building • ATLANTA, GA., 1221 Mortgage Guarantee Bldg. BOSTON, MASS., 115 Peterboro St. • CHICAGO, ILL., Room 1336, 122 So. Michigan Avenue • FLANDREAU, S. D., 315 No. Crescent Street • KANSAS CITY, MO., 422 B. M. A. Bldg. • LITTLE FALLS, N. J., Box 91 • LOS ANGELES, CALIF., 448 So. Hill Street • OMAHA 5, NEBR., 3812 Castellar Street • RICHMOND 19, VA., 210 East Franklin Street • SALT LAKE CITY, UTAH, 149-151 W. Second South St. • SAN FRANCISCO, CALIF., 681 Market St. • SIGNAL MOUNTAIN, TENN., 204 Slayton Street • WACO, TEXAS, P. O. Box 887 • MONTREAL, 2028 Union Avenue • WINNIPEG, 576 Wall St. HAVANA • MAYAGUEZ, PUERTO RICO • BOGOTA • CARACAS • MEXICO CITY.

(*Continued from page 14*)

Rolf Eliassen has been appointed professor of sanitary engineering in charge of both graduate and undergraduate work in this field at the Massachusetts Institute of Technology. He is also to supervise a research program in the analysis, purification and disposal of industrial wastes, as well as studies in the pollution and purification of water supplies. Dr. Eliassen is a graduate of M.I.T., class of 1932, and holds M.S. and Sc.D. degrees which he received in 1933 and 1935. Upon completion of his education, he worked with two consulting engineering firms and then joined the Illinois Institute of Technology in 1939 as assistant professor of sanitary engineering. One year later he became associate professor of sanitary engineering and director of the Sanitary Engineering Research Laboratory of New York Univ. During World War II he served in the Corps of Engineers, taking charge of the sanitary engineering division of the Second Service Command and attaining the rank of lieutenant colonel. He returned to his post at New York Univ. as a full professor after the war.

The collectomobile, an armored car manned by two cashiers, is a new means by which the Consolidated Edison Co. of New York hopes to speed up collections and improve its relations with customers by bringing its district collection office to them. Beginning in its remote Queens service district, Con Ed's cashiers on wheels tour the area on a pre-announced monthly schedule which involves all-day stops at nineteen locations and half-day stops at two others. Making it easy for housewives to settle their accounts on time and on the spot, these go-getters have also enlisted the aid of small-fry free-lance agents in each neighborhood by including in their equipment a tempting supply of lollipips for customer progeny.

Water works men who have been undergoing the ordeals of the traditional district collection agency setup will quickly recognize the advantages of this system. By keeping all funds always in the hands of its own personnel and by assuring the rapid delivery of those funds to its own coffers, a utility will be able to exercise complete control over its collections and collection policy, thereby reducing not only unnecessary expense, but unnecessary friction with customers who have paid their bills but have not received credit for so doing. More than that, the collectomobile staff can well do a positive job of public relations in its direct contact with customers —distributing literature, presenting exhibits, perhaps even accepting complaints. With or without lollipops, the collectomobile seems well worth investigation.

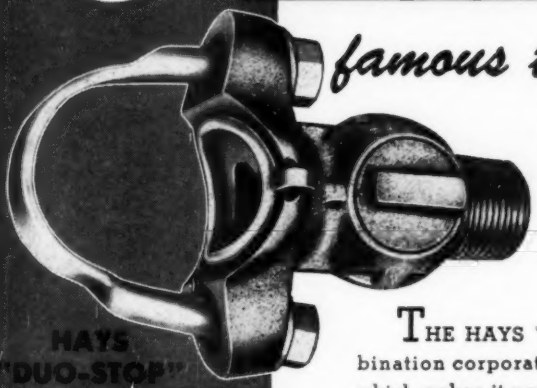
Neptune Meter Co. has moved its Chicago branch to larger quarters at 4048 W. Taylor St., Chicago 24, in order to enlarge its laboratory and service facilities. The office will also provide space for the newly acquired Rensselaer Valve Co. Div.

(*Continued on page 18*)

HAYS

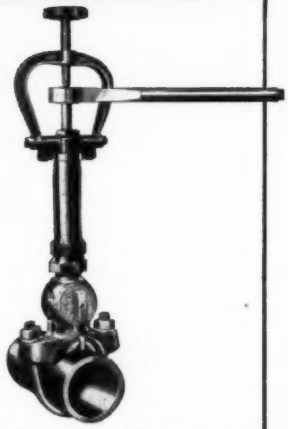
WATER SERVICE PRODUCTS

famous throughout the world



THE HAYS "Duo-Stop" is a combination corporation stop and saddle which makes it unnecessary to buy corporation stops and service clamps or saddles separately. It is designed to install on 2 inch mains, either cast iron or steel . . . requires no tapping of the main and can be installed without interruption of service. It can be supplied with outlet for iron pipe, copper service, or various types of thread.

Hays Manufacturing Company is one of the largest making a complete line of water service products, and throughout eighty years the name HAYS has been a guarantee of quality. Every HAYS fitting is precision machined, specially lubricated for enduring operation, and hydrostatically tested at 200 pounds or more. All corporation stops can be installed with any standard tapping machine equipment.



HAYS Main Drilling Machine for installing HAYS "Duo-Stop." Ask for our new complete catalog of water service products.

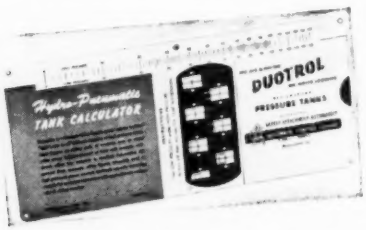
HAYS
COPPER · BRASS · LEAD · IRON
WATER WORKS PRODUCTS
HAYS MANUFACTURING CO., ERIE, PA.

(*Continued from page 16*)

"America's Health," a report to the nation by the National Health Assembly, has been published in book form by Harper & Brothers, 49 E. 33rd St., New York, and is priced at $4.50. The assembly was convened in Washington, D.C., during May 1948 by Federal Security Administrator Oscar R. Ewing at the request of President Truman, and consisted of about 800 representatives of professional organizations and public and private agencies. On the planning committee for the environmental sanitation group were such men as Arthur D. Weston (committee chairman), Earnest Boyce, Alfred H. Fletcher, W. L. Mallmann, Sol Pincus, B. A. Poole, Harold B. Gotaas, John H. O'Neill, E. A. Reinke, Jerome H. Svore, and others familiar to A.W.W.A. members and JOURNAL readers. Despite such provocative statements as:

> There are strong indications that the long-honored test for the safety of drinking water, the coliform index, may furnish only part of the information that is necessary to enable us to determine whether a drinking-water supply is safe. There may be unrecognized contaminants of water which have an important bearing upon the incidence of disease, just as the role water may play in the spread of certain diseases may not be understood. . . .

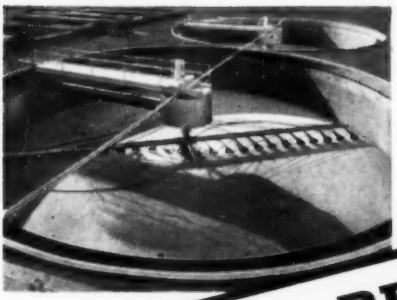
the report confined its water supply findings largely to thumbnail analyses and recommendations long familiar to A.W.W.A. members—the need for control of ground water, pollution abatement and control, conservation, research in water treatment and appraisal of water quality. For the layman, however, the section should prove valuable in rounding out his picture of the subject.



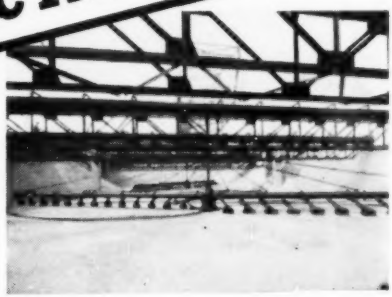
A hydropneumatic tank calculator based on Boyle's Law has been devised by the Automatic Control Co., 1005 University Ave., St. Paul 4, Minn., and sells for $1. Determination of the best air-water ratio, most efficient pressure differential, pressure drop for any given withdrawal of water, and the resulting reserve or residual is made possible by various scales on the slide-rule type device.

"The Great Gildersleeve" finally has himself a real water works job. After measuring his achievements as Water Commissioner more in audience decibels than in laboratory ppm., radio's gift to water works men will appear in a series of pictorial advertisements of the Pittsburgh Equitable Meter Div., Rockwell Mfg. Co., illustrating a revolutionary scheme for improving public relations in mythical Summerfield. His presentation by Rockwell is through the courtesy of Kraft Foods Co., his sponsor. The first ad in the series may be seen on the last page of this JOURNAL.

(*Continued on page 22*)



ROUND or RECTANGULAR



Only Rex Tow-Bro Assures Positive Sludge Removal Control . . .

Only the Rex Tow-Bro Sludge Remover gives you positive control of sludge removal from round or rectangular settling tanks over a wide range of withdrawal rates. Because Tow-Bro removes sludge from the tank bottom by a gentle suction instead of the conventional plowing or scraping action, it provides ideal handling of light flocculent solids. Just check these advantages that only Tow-Bro gives you:

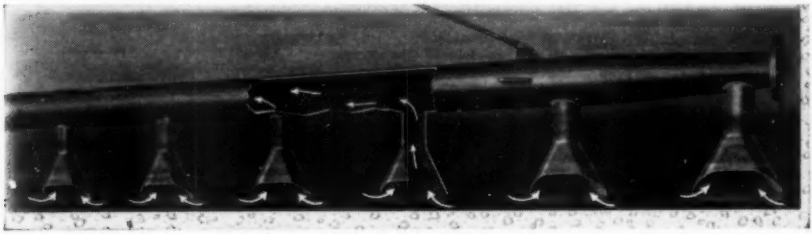
***Clearer Effluent** because the gentle suction removes sludge with a minimum of disturbance, assuring a better settling condition and a clearer effluent.

***Low Cost**, both construction and operating, because tank bottom is pitched only enough to insure drainage, thus cutting construction costs. No sludge hopper or center pier required. Greater solids concentration means less volume . . . smaller piping . . . less pumping time. In one revolution, all the sludge may be removed from the entire tank bottom. Sludge volume is smaller, leaving more capacity through settling tanks.

***Prevents Septicity** since sludge is in the settling tanks a shorter time.

***Greater Operating Flexibility** since sludge may be drawn off at a faster rate . . . even a light blanket . . . without dilution.

Investigate the Rex Tow-Bro for your plant. It is easily adapted to new or existing tanks. For complete details on Tow-Bro and the other Rex Sanitation and Process Equipment, send for your copy of Bulletin No. 48-41. Chain Belt Company, 1609 West Bruce Street, Milwaukee 4, Wis.



Arrows indicate direction of sludge removal from tank bottom with Rex Tow-Bro.

CHAIN BELT REX COMPANY SANITATION EQUIPMENT

ASK UTICA, NEW YORK

CAST IRON PIPE

ABOUT CAST IRON PIPE!

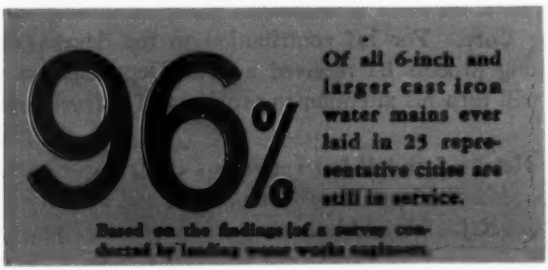
In 1849—one hundred years ago—Utica laid her first 6-inch cast iron pipe. Of all the 6-inch cast iron pipe laid from that date, 98.2% is still in service.

In the same year, Utica installed her first 12-inch cast iron pipe and 99% of all the 12-inch cast iron pipe laid from that date is still in service.

Utica is one of the cities included in the survey of "Survival and Retirement Experience with Water Works Facilities," including cast iron water mains, conducted under the auspices of the American Water Works Association, the New England Water Works Association and the Institute of Water Supply Utilities. The recently published report of the findings of the survey shows that 96% of all 6-inch and larger cast iron water mains ever laid since 1817 in 25 representative cities are still in service.

Utica's experience with cast iron water mains, therefore, while remarkable, and eminently satisfactory to her taxpayers, is not exceptional.

We shall be glad to send on request a copy of our brochure "Survival and Retirement Experience with Cast Iron Water Mains," reprinted by permission. Address Thomas F. Wolfe, Engineer, Cast Iron Pipe Research Association, 122 South Michigan Avenue, Chicago 3, Illinois.


96%
Of all 6-inch and larger cast iron water mains ever laid in 25 representative cities are still in service.
Based on the findings of a survey conducted by leading water works engineers.

SERVES FOR CENTURIES

(Continued from page 18)

The Detroit water board's infiltration gallery has one pin-up boy these days—an engineer discharged upon suspicion of being a "Communist." Ignoring a city charter provision forbidding dismissal of employees for membership in any political party (and the Communist Party is legal in Michigan), the mayor and secretary of the civil service commission discharged the man because he refused to say that he wasn't, or even that he was, a member of the party. Indicating that the courts would be taking responsibility for his activities if they reinstated him, the authorities thus placed themselves on record as "not coddling Communists."

In tune, too, with the hystery of the times is a water works story from Baldwin Park, Calif., which rated a front-page photo in the New York *Sun*. Although the sitdown strike may be slightly dated as an attention-getter in these days of international indignations, its adoption by housewives and their infants still involves enough of a "man bites dog" situation to hit the headlines. Thus when voluble kitchen brigades occupied the trenches in which employees of the Baldwin Park County Water Dist. were attempting to install meters on its services, the posterior performance was duly recorded for posterity.

Background of this pantry protest against metering must have been an unsuccessful public relations job, for it is difficult to believe that the battling housewives were particularly anxious to pay for their neighbors' drips, as undoubtedly they had been doing under the superseded flat-rate charge. As with almost all our clamor for inequity, this mistaken zeal, too, can be credited to ignorance of the facts involved.

Sidney Sussman has become associated with Water Service Labs., Inc., of New York, as chief chemist. His previous background includes positions at E. I. du Pont de Nemours & Co., Permutit Co., and Liquid Conditioning Corp. For his contribution to the development of a seawater desalting process he received a War Dept. citation. In his new position he will turn his attention to problems of corrosion prevention.

Harry Nelson Lendall has retired as chairman of the department of civil engineering and professor of municipal and sanitary engineering at Rutgers Univ., N.J. He had been on the faculty for 37 years, having come to the school after earlier experience working for the city of Waterbury, Conn., the Boston & Maine Railroad, and three years as a mathematics instructor at the Univ. of Pennsylvania. He was responsible for instituting water and sewage works short courses at Rutgers, and participated in the Army Specialized Training Program during World War II. In addition, he has performed a wide range of consulting work.

THE VALUE
of a NAME
GREAT NAMES in industry are achieved by making a better product and rendering a better service. Just a name will never make a lasting success if the product or service is of inferior quality.
The continuing superiority of HERSEY WATER METERS for more than sixty years has won for the name HERSEY an enviable position in the water works industry.
HERSEY
MANUFACTURING
COMPANY
SOUTH BOSTON
MASS.

Professional Services

ALBRIGHT & FRIEL, INC.

Consulting Engineers

Water, Sewage and Industrial Waste Problems
Airfields, Refuse Incinerators, Power Plants
Industrial Buildings
City Planning Reports Valuations
Laboratory

121 S. Broad St. **Philadelphia 7, Pa.**

BOWE, ALBERTSON & ASSOCIATES

Engineers

Sewerage—Sewage Treatment
Water Supply—Purification
Refuse Disposal—Analyses
Valuations—Reports—Designs

110 Williams St. **New York 7, N.Y.**
2082 Kings Highway **Fairfield, Conn.**

Chas. B. Burdick Louis R. Howson
Donald H. Maxwell

ALVORD, BURDICK & HOWSON

Engineers

Water Works, Water Purification, Flood Relief, Sewerage, Sewage Disposal Drainage, Appraisals, Power Generation

Civic Opera Building **Chicago 6**

BUCK, SEIFERT AND JOST

Consulting Engineers
(Formerly Nicholas S. Hill Associates)

Water Supply—Sewage Disposal—Hydraulic Developments

Reports, Investigations, Valuations, Rates, Design, Construction, Operation, Management, Chemical and Biological Laboratories

112 E. 19th St., New York 3, N. Y.

CARL A. BAYS & ASSOCIATES

Geologists—Engineers—Geophysicists
Industrial Consultants

Office and Laboratory—308 N. Orchard St.
Mail Address—P.O. Box 189
Urbana, Illinois

BURGESS & NIPLE

Civil & Sanitary Engineers

Water Supply and Purification

Sewerage and Sewage Treatment

584 E. Broad St. **Columbus 15, Ohio**

A. S. BEHRMAN

Chemical Consultant

Water Treatment
Ion Exchange Processes and Materials
Patents

9 S. Clinton St. **Chicago 6, Ill.**

BURNS & McDONNELL ENGINEERING CO.

Consulting Engineers—51 Years

Water Works, Light and Power, Sewerage, Reports, Designs, Appraisals, Rate Investigations.

Box 7088 Country Club P.O., Kansas City 2, Mo.
Office: 95th & Troost Ave.

BLACK & VEATCH

Consulting Engineers

4706 Broadway, Kansas City 2, Mo.

Water Supply Purification and Distribution; Electric Lighting and Power Generation, Transmission and Distribution; Sewerage and Sewage Disposal; Valuations, Special Investigations and Reports

JAMES M. CAIRD

Established 1898

C. E. Clifton, H. A. Bennett

Chemist and Bacteriologist

WATER ANALYSIS
TESTS OF FILTER PLANTS

Cannon Bldg. **Troy, N. Y.**

CLINTON L. BOGERT ASSOCIATES

Consulting Engineers

Clinton L. Bogert Ivan L. Bogert
J. M. M. Greig Robert A. Lincoln
Donald M. Ditmars Arthur P. Ackerman

Water and Sewage Works
Refuse Disposal Industrial Wastes
Drainage Flood Control

624 Madison Avenue **New York 22, N. Y.**

CAMP, DRESSER & McKEE

Consulting Engineers

Water Works, Water Treatment, Sewerage and Wastes Disposal, Flood Control

Investigations, Reports, Design Supervision, Research, Development

6 Beacon St. **Boston 8, Mass.**

THE CHESTER ENGINEERS

Water Supply and Purification,
Sewerage Systems, Sewage and
Industrial Waste Treatment,
Power Development and Applications,
Investigations and Reports,
Valuations and Rates

210 E. Park Way at Sandusky
PITTSBURGH 12, PA.

GILBERT ASSOCIATES, INC.

Engineers and Consultants

Water Supply and Purification
Sewage and Industrial Waste Treatment
Chemical Laboratory Service
Investigations and Reports

New York **Reading, Pa.** **Washington**
Houston **Philadelphia**

CONSOER, TOWNSEND & ASSOCIATES

Water Supply—Sewerage
Flood Control & Drainage—Bridges
Ornamental Street Lighting—Paving
Light & Power Plants—Appraisals

351 E. Ohio St. **Chicago 11**

IVAN M. GLACE

Consulting Sanitary Engineer

Water Supply and Purification
Sewerage, Sewage and Industrial
Wastes Treatment
Design, Construction & Supervision of
Operation
Laboratory Service

1001 N. Front St. **Harrisburg, Pa.**

DE LEUW, CATHER & COMPANY

Water Supply — Sewerage
Railroads — Highways

Grade Separations—Bridges—Subways
Local Transportation

Investigations—Reports—Appraisals
Plans and Supervision of Construction

150 N. Wacker Drive **79 McAllister St.**
Chicago 6 **San Francisco 2**

GREELEY & HANSEN

Engineers

Water Supply, Water Purification
Sewerage, Sewage Treatment
Flood Control, Drainage, Refuse Disposal

220 S. State Street, Chicago 4

FAY, SPOFFORD & THORNDIKE

Engineers

Charles E. Spofford — Ralph W. Horne
John Ayer — William L. Hyland
Bion A. Bowman — Frank L. Lincoln
Carroll A. Farwell — Howard J. Williams

WATER SUPPLY AND DISTRIBUTION—DRAINAGE
SEWERAGE AND SEWAGE TREATMENT—AIRPORTS

Investigations Reports Designs Valuations
Supervision of Construction

Boston **New York**

HAVENS & EMERSON

W. L. HAVENS C. A. EMERSON
A. A. BURGER F. C. TOLLES F. W. JONES

Consulting Engineers

Water, Sewage, Garbage, Industrial
Wastes, Valuations—Laboratories

Leader Bldg. **Woolworth Bldg.**
CLEVELAND 14 **NEW YORK 7**

O. S. FENT

Consulting Ground Water Geologist

Water Supply Surveys
Complete Test Drilling Service

Box 477 **Salina, Kansas**

CHARLES HAYDOCK

Consulting Engineer

Water Works and Sanitation Industrial Wastes
Design, Construction, Operation and Management
Reports and Valuations

Commercial Trust Building **Philadelphia 2**

GANNETT FLEMING CORDDRY & CARPENTER, Inc.

Engineers

Water Works—Sewerage
Industrial Wastes—Garbage Disposal
Roads—Airports—Bridges—Flood Control
Town Planning—Appraisals
Investigations & Reports

Harrisburg, Pa.
Scranton, Pa. **Pittsburgh, Pa.**

HITCHCOCK & ESTABROOK, INC.

Lester D. Lee, Associate
Consultants to Municipalities since 1920

Water, Sewerage, Paving, Power Plants,
Airports, Reports and Appraisals

521 Sexton Bldg., Minneapolis 15, Minn.

Professional Services

HORNER & SHIFRIN

Consulting Engineers

W. W. Horner
H. Shifrin
S. W. Jens
E. E. Bloss
V. C. Lischer

Water Supply—Airports—Hydraulic Engineering—Sewerage—Sewage Treatment—Municipal Engineering—Reports

Shell Building **St. Louis 3, Mo.**

METCALF & EDDY

Engineers

Water, Sewage, Drainage, Refuse and Industrial Wastes Problems
Airfields Valuations
Laboratory

Statler Building, Boston 16

ROBERT W. HUNT CO.

Inspection Engineers

(Established 1888)

Inspection and Test at Point of Origin of Pumps, Tanks, Conduit, Pipe and Accessories

175 W. Jackson Blvd.
Chicago 4, Ill.
and Principal Mfg. Centers

THE H. C. NUTTING COMPANY

Engineers

Water Distribution Studies
Water Waste Surveys
Trunk Main Surveys
Meter and Fire Flow Test

4120 Airport Road **Cincinnati 26, Ohio**

JONES, HENRY & SCHOONMAKER

(Formerly Jones & Henry)

Consulting Sanitary Engineers

Water Works
Sewerage & Treatment
Waste Disposal

Security Bldg. **Toledo 4, Ohio**

Parsons, Brinckerhoff, Hall & Macdonald

G. Gale Dixon, Associate

Engineers

Dams Water Works Sewerage
Airports Bridges Tunnels
Traffic & Transportation Reports Highways
Subways Foundations
Harbor Works Valuations
Power Developments Industrial Buildings

51 Broadway, New York 6, N.Y.

MORRIS KNOWLES, INC.

Engineers

Water Supply and Purification,
Sewerage and Sewage Disposal,
Industrial Wastes, Valuations,
Laboratory, City Planning.

Park Building **Pittsburgh 22, Pa.**

MALCOLM PIRNIE ENGINEERS

Civil & Sanitary Engineers

MALCOLM PIRNIE
RICHARD HAZEN
ERNEST W. WHITLOCK
G. G. WERNER, JR.

Investigations, Reports, Plans
Supervision of Construction and Operations
Appraisals and Rates

25 W. 43rd St. **New York 18, N. Y.**

R. M. LEGGETTE

Consulting Ground Water Geologist

Water Supply Salt Water Problems
Dewatering Investigations
Recharging Reports

551 Fifth Avenue **New York 17, N. Y.**

THE PITOMETER COMPANY

Engineers

Water Waste Surveys
Trunk Main Surveys
Water Distribution Studies
Penstock Gaugings

50 Church St. **New York 7, N. Y.**

Roberto Meneses Hoyos & Co.

Ground Water Engineers

Water Supply Geophysics
Test Drilling Flow Tests
Explorations Reports
Design, Valuations & Supervision

Reforma 12 **Mexico City**

LEE T. PURCELL

Consulting Engineer

Water Supply & Purification; Sewerage & Sewage Disposal; Industrial Wastes; Swimming Pool Control; Investigations & Reports; Design; Supervision of Construction; Operation

Analytical Laboratories

1 Lee Place **Paterson 1, N. J.**

RIPPLE & HOWE
Consulting Engineers

O. J. Ripple B. V. Howe

Appraisals—Reports
Design—Supervision

Water Works Systems, Filtration and Softening Plants, Reservoirs, and Dams, Sanitary and Storm Sewers, Sewage Treatment Plants, Refuse Disposal, Airports

426 Cooper Bldg., Denver 2, Colo.

ALDEN E. STILSON & ASSOCIATES
Limited
Consulting Engineers

Water Supply Sewerage Waste Disposal
Mechanical Structural

Surveys Reports Appraisals

209 South High St. Columbus, Ohio

NICHOLAS A. ROSE
Consulting Ground Water Geologist

Investigations
Reports
Advisory Service

1309 Anita Ave. Houston 4, Tex.

WARD & STRAND
Engineers

Clayton N. Ward John A. Strand

Water Works
Water Purification
Sewerage
Flood Control
Irrigation & Drainage
Power—Water, Steam & Diesel
Hydraulic Testing
Hydrological Investigation

1 West Main St. Madison 3, Wisconsin

RUSSELL & AXON
Consulting Engineers

Geo. S. Russell F. E. Wenger
Joe Williamson, Jr.

Water Works, Sewerage, Sewage Disposal, Industrial and Power Plants, Appraisals

408 Olive St. St. Louis 2, Mo.
Municipal Airport Daytona Beach, Fla.

WESTON & SAMPSON
Consulting Engineers

Water Supply and Purification; Sewerage, Sewage and Industrial Waste Treatment. Reports, Designs, Supervision of Construction and Operation; Valuations. Chemical and Bacteriological Analyses

14 Beacon Street Boston 8, Mass.

A. W. W. A.
Membership Certificate

Membership certificate, 8½ x 11 in., suitable for framing, 40¢.

Submit name exactly as it should appear on certificate.

American Water Works Association, Inc.
500 Fifth Avenue New York 18, N. Y.

WHITMAN & HOWARD
Engineers
(Est. 1869.)

Investigations, Designs, Estimates, Reports and Supervision, Valuations, etc., in all Water Works and Sewerage Problems

89 Broad St. Boston, Mass.

J. E. SIRRINE COMPANY
Engineers

Water Supply & Purification,
Sewage & Industrial Waste Disposal,
Stream Pollution Reports,
Utilities, Analyses

Greenville South Carolina

WHITMAN, REQUARDT & ASSOCIATES
Engineers *Consultants*

Civil—Sanitary—Structural
Mechanical—Electrical
Reports, Plans,
Supervision, Appraisals

1304 St. Paul St. Baltimore 2, Md.

STANLEY ENGINEERING COMPANY

Waterworks—Sewerage
Drainage—Flood Control
Airports—Electric Power

Hershey Building
Muscatine, Ia.

WILLING WATER
Public Relations Consultant

Willing Water cartoons available in low-cost blocked electrotypes and newspaper mats for use in building public and personnel good will.

Send for catalog and price list

American Water Works Association, Inc.
500 Fifth Avenue New York 18, N.Y.

Membership Changes

NEW MEMBERS

Applications received June 1 to 30, 1949

Archambault, L. A., Cons. Engr., Archambault & Towle, 57 Main St., Magog, Que. (July '49)

Banister, A. W., Partner, Banister Eng. Co., 1549 University Ave., St. Paul 4, Minn. (July '49)

Beck, John, Asst. Chief Chemist, Hollingsworth & Whitney Co., Box 1189, Mobile 7, Ala. (July '49)

Bishop, Raymond F., Supt., Water Dept., Boonville, Mo. (July '49) *MP*

Boynton, Eugene Warren, III, Asst. Gen. Mgr., Northern Gravel Co., Muscatine, Iowa (July '49) *P*

Brabson, Lester C., Supt., Water & Light Dept., Lenoir City, Tenn. (July '49)

Bus, Edward S., Sales Engr., Dearborn Chemical Co., 4738—38th, N.E., Seattle 5, Wash. (July '49) *P*

Cedar Grove, Township of, Water Dept., Harry P. Farro, Water Supt., Cedar Grove, N.J. (Corp. M. July '49) *M*

Coble, Roy E., Engr., San Jose Hills Water Co., 1117 S. Cordova, Alhambra, Calif. (July '49)

Craun, Bernard T., Jr. San. Engr., Bureau of Sanitation, State Dept. of Health, Phoenix, Ariz. (July '49) *PR*

Cutler, John, Mech. Engr., Corn Products Refining Co., 201 N. Wells St., Chicago 6, Ill. (July '49) *PR*

Davidson, Charles M., Public Health Engr., Tennessee Valley Authority, 216 OPO, Chattanooga, Tenn. (July '49) *PR*

Denize, Clement F., Student, San. Eng., Harvard Graduate School, 63 Gorham St., Cambridge 38, Mass. (July '49) *MP*

Disch, Arthur J., Water Registrar, Village of Whitefish Bay, 801 E. Lexington Blvd., Milwaukee 11, Wis. (July '49) *M*

Diskant, Eugene M., Chemist, Dept. of Water & Power, Box 3669 Terminal Annex, Los Angeles 54, Calif. (July '49)

Driggs, Richard J., West Coast Dist. Mgr., Dresser Mfg. Div., 544 Market St., San Francisco, Calif. (July '49) *M*

Dunlap, Frederick P., Supt., Public Works Dist. No. 2, 119 E. Abriendo Ave., Pueblo, Colo. (July '49)

Elliott, Robert S., Village Clerk & Water Supt., Hilton, N.Y. (July '49) *MP*

Ellsworth, Kenneth, Supt., Water Works, Water Dept., Romeo, Mich. (July '49)

Farro, Harry P., *see* Cedar Grove, Township of

Fischer, Felix George, Supervisor of Plumbing, Sewerage & Water Board, 526 Carondelet St., New Orleans 12, La. (July '49) *P*

Garcia, Ignacio, Student, Ave. de America 153, Alturas de Almendares, Havana, Cuba (July '49)

Gilbert, Marc, Civ. Engr., 251 St. Joseph St., Quebec, Que. (July '49) *MPR*

Glenn, W. Ivy, Water Works Supt., Laurel, Miss. (July '49)

Gravel, C. E., Cons. Engr., 87 Levesque Blvd., L'Abord-A-Plouffe, Que. (July '49)

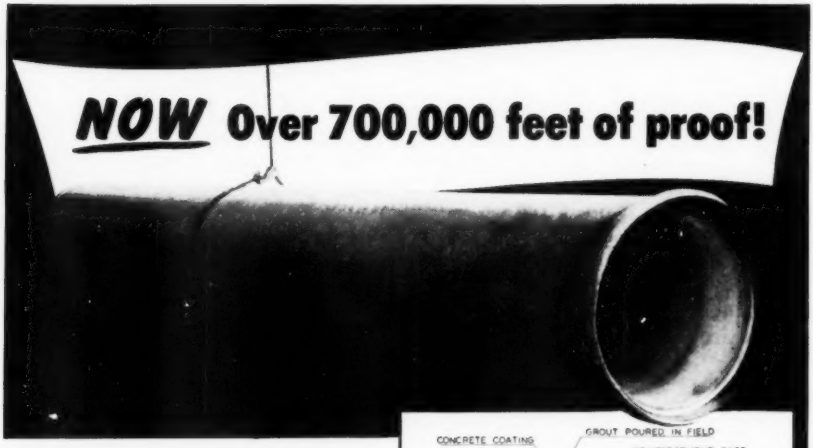
Hale, Thomas Shaw, Director, New York Water Service Corp., 90 Broad St., New York 4, N.Y. (July '49)

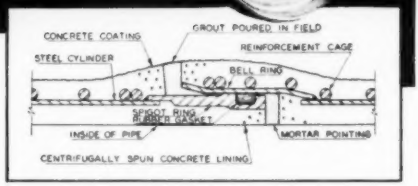
Hamilton, Robert A., Jr., Secy. & Supt. of Constr., Utilities Service Corp., 409 S. River St., Hackensack, N.J. (July '49)

Hanson, Joseph H., Chemist, Water Dept., 215 W. Broadway, Long Beach, Calif. (July '49)

Herring, Thomas Francis, Vice-Pres. in Charge of Sales & Service, National Tech. Labs., 820 Mission St., South Pasadena, Calif. (Jan. '49) *P*

(Continued on page 30)





American Concrete Cylinder Pipe helps reduce the cost of delivered water throughout Pacific States

Although the Company began the development and manufacture of American Concrete Cylinder Pipe eighteen years ago, 1941 marks the first appearance of this composite, modified prestressed pipe in its present form. Since 1941, this pipe has become established throughout the West as one of the outstanding developments in the field of pressure transmission of water. American Concrete Cylinder Pipe combines efficiency and economy in the medium diameter range from 14" to 36" inclusive and in the range of operating pressures from 100 psi upward. This pipe is manufactured in nominal lengths of 30 feet. Its design incorporates the physical properties of steel with the protection and permanency of concrete. The Lock Joint Rubber Gasket Joint simplifies installation—assures positive water-tightness under normal operating conditions.

The economies of American Concrete Cylinder Pipe are reflected in initial cost, ease of installation, sustained capacity, and trouble-free service. All of these factors mean substantial savings in the cost of delivered water. Complete information available upon request.

IN PACIFIC NORTHWEST . . .

Now, in addition to complete plants at Los Angeles and Oakland, the company's Portland Plant is fully equipped to furnish American Concrete Cylinder Pipe to water users in the Pacific Northwest. Inquiries to Box 1898, Piedmont Station, Portland 11, will receive prompt attention.

American PIPE AND CONSTRUCTION CO.

Concrete Pipe for Main Water Supply Lines, Storm & Sanitary Sewers, Subaqueous Pipe Line

P. O. Box 3428, Terminal Annex, Los Angeles 54, California
Main Offices and Plant—4635 Firestone Blvd., South Gate, Calif.
District Sales Offices and Plants—Oakland, San Diego, Portland, Oregon

(*Continued from page 28*)

Hodges, James Earl, Southwestern Div. Mgr., R. W. Sparling, 726 Reserve Loan Life Bldg., Dallas 1, Tex. (July '49) *P*

Keller, James H., Chemist, Water Dept., 602 Civic Center, San Diego, Calif. (July '49) *MP*

Ketcham & Nongard, Tuthill Ketcham, Partner, 105 W. Adams St., Chicago 3, Ill. (Corp. M. July '49) *MPR*

Ketcham, Tuthill, *see* Ketcham & Nongard

Losch, E. C., Owner, Berlu Water Co., 8302 E. Center St., Paramount, Calif. (July '49)

Lucas, A. J., Dist. Mgr., Peoples Water Service Co., Box 109, Walterboro, S.C. (July '49)

Lucas, Harley E., Civ. Engr. & Acting City Mgr., Box 388, Norton, Kan. (July '49)

Meindl, J. A., Mgr., Permutit Sales, Walter Kidde & Co. of Canada, Ltd., 6975 Jeanne Mance St., Montreal 15, Que. (Apr. '49)

Meridian, City of, George J. Roark, City Mgr., Meridian, Miss. (Corp. M. July '49) *MPR*

Metz, Roy, Supt., Water & Sewage Plants, Carthage, Ill. (July '49)

Morgan, Martin William, Sales Engr., Wallace & Tiernan Co., Inc., 1229 W. Washington Blvd., Chicago, Ill. (July '49) *P*

Nagle, M. F., *see* South Amboy Board of Public Works

Nicholson, Richard W., City Engr., City Hall, South Milwaukee, Wis. (July '49) *MP*

Patel, Bapubhai D., Tech. Director, Hydraulic Development Corp., Boring Bldg., Ahmedabad 8, India (July '49)

Pomar, Albert C., *see* St. Augustine Water Treatment Dept.

Price, William Alexander, Supt., Water Works, Tara, Ont. (July '49)

Quay, Joe T., Filter Plant Operator, Commander Mills, Inc., Sand Springs, Okla. (July '49)

Roark, George J., *see* Meridian, City of

St. Augustine, City of, Water Treatment Dept., Albert C. Pomar, Supt., 254 W. King St., St. Augustine, Fla. (Corp. M. Jan. '49)

Shales, J. S. L., Sales Engr., The Canadian Fairbanks-Morse Co., Ltd., 137–167 Harbour St., Toronto, Ont. (July '49)

Sherman, George W., Supt., Water Dept., Fort Atkinson, Wis. (July '49) *M*

South Amboy Board of Public Works, M. F. Nagle, Supt., Water Dept., City Hall, South Amboy, N.J. (Corp. M. July '49)

Spence, George, Comr., Dept. of External Affairs, 3150 Rae St., Regina, Sask. (Apr. '49)

Stillwell, James T., Water Works Supt., Fayson Lakes, Inc., Box 7, Fayson Lakes, N.J. (July '49) *MP*

Stodart, James, Designing Water Works Engr., City Engr.'s Office, City Hall, Hamilton, Ont. (July '49)

Suarez, Dionisio, Chief Dist. Engr., Public Works, Calle 8, No. 565, Vedado, Havana, Cuba (July '49)

Sullivan, Ray D., Comr. of Public Works, 3930 N. Murray Ave., Shorewood 11, Wis. (July '49) *M*

Suryaprakasam, M. V., San. Eng. Dept., Johns Hopkins Univ., Baltimore 18, Md. (July '49)

Tatarian, S. Myron, Civ. Engr., Water Dept., 425 Mason St., San Francisco, Calif. (July '49)

Turnbull, Donald O., Cons. Engr., 42 Princess St., Saint John, N.B. (July '49)

Van Orden, James H., Cons. Engr., James H. Van Orden & Assoc., Box 323, Chicago 90, Ill. (July '49)

Voelker, Philip Leslie, Sales Engr., Builders-Providence, Inc., Box 1342, Providence, R.I. (July '49) *P*

Wagner, Harold, Supt., Munic. Light & Water Dept., 122 W. Main, Sebewaing, Mich. (July '49)

Welter, Roy, San. Engr., Suerdrup & Parcel, 1118 Syndicate Trust Bldg., St. Louis, Mo. (July '49)

Young, Max, Mgr., Judsonia Water Co., Inc., Judsonia, Ark. (July '49) *M*

REINSTATEMENTS

Helton, Glenn William, Pres., Benton County Water Co., Inc., Box 96, Gravette, Ark. (Apr. '48) *P*

Johnson, Francis M., Lt. Col., 119 Brevard Rd., Asheville, N.C. (Oct. '37)

(*Continued on page 32*)

MORE PUMP
POMONA!
Any way you measure it, a Fairbanks-Morse Pomona gives you more for your pump dollar . . . in performance . . . in efficiency . . . in low-cost operation and maintenance.
Combine such features as true water lubrication . . . trouble-free open impellers . . . smooth, quiet revolvable rubber shaft bearings . . . simple "at the surface" capacity adjustment . . . plus the Fairbanks-Morse reputation for unsurpassed quality . . . and it's easy to see why.
Your Fairbanks-Morse Pomona Pump Distributor or branch pump engineer will be happy to give you the complete story on the pump that gives you more . . . Pomona! Fairbanks, Morse & Co., Chicago 5, Ill.
FAIRBANKS-MORSE,
a name worth remembering
DIESEL LOCOMOTIVES • DIESEL ENGINES • PUMPS • SCALES
MOTORS • GENERATORS • STOKERS • RAILROAD MOTOR
CARS and STANDPIPES • FARM EQUIPMENT • MAGNETOS

(Continued from page 30)

Machis, Alfred, Research Assoc. in San Eng., Johns Hopkins Univ., Baltimore, Md. (Apr. '43) *M*

LOSSES

Deaths

Black, Ernest B., Partner, Black & Veatch, Cons. Engrs., 4706 Broadway, Kansas City 2, Mo. (June '13) *MP*

Mallalieu, Willard, San. Engr., Jersey City Bureau of Water, Box 188, Boonton, N.J. (Dec. '14) *MP*

Ricks, R. A., Supt., Filtration Plant, State Farm, Va. (July '48)

Schmitt, Herbert Clarence, Asst. Supt. of Filtration, Water Dept., City Hall, Milwaukee, Wis. (July '38) *P*

Wagner, A. H., Supt., Public Water Works Dist. No. 2, 119 E. Abriendo Ave., Pueblo, Colo. (Mar. '28)

Resignations

Dahle, C. A., Supt., Water Utility, City Hall, Stoughton, Wis. (July '35) *M*

Kenwell Corp., S. Kenneth Weiser, Pres. & Gen. Mgr., 1919 Bonita Drive, Glendale 8, Calif. (Assoc. M. July '47)

Mercer, B. F., Water Comr. & City Treas., Water Dept., Sidney, Mont. (Oct. '42) *M*

Peterson, Wesley C., Supt., Water Dept., New London, Iowa (Apr. '48)

CHANGES IN ADDRESS

Changes received between June 5 and July 5, 1949

Andres Casco, A., 309—11th St., Columbus, Ga. (Jr. M. Jan. '49)

Angelotti, Tony, Supt., Water Dept., 1 River St., Willoughby, Ohio (Oct. '47)

Augustus, A. Stewart, Louisville Water Co., 435 S. 3rd St., Louisville 2, Ky. (Apr. '47) *M*

Balshaw, Frank E., Water Works Engr., Calgary Power, Ltd., 140—1st Ave., W., Calgary, Alta. (Jan. '44) *MP*

Black, Wallace, Ridge Rd., Cedar Grove, N.J. (July '43) *M*

Caverly, David S., Asst. San. Engr., San. Eng. Div., Ontario Dept. of Health, 5509 Parliament Bldgs., Toronto, Ont. (Jan. '45) *P*

Collins, W. L., 2416 Truxillo, Houston, Tex. (Jan. '47)

Cook, John H., 243 Walthery Ave., Ridgewood, N.J. (July '06) *Honorary M. '47.*

Cornell, Charles Brown, 225 City Hall, Columbus, Ohio (May '28)

Cramer, H. Cable, Mgr., Catlettsburg, Kenova & Ceredo Water Co., 5 Central Bldg., 6th Ave. & 9th St., Huntington, W.Va. (Jan. '40) *M*

Dutton, Marshall S., 619 N. Grove, Oak Park, Ill. (Apr. '37) *M*

Eyer, Chet, 520 N. 18th St., Billings, Mont. (Apr. '47) *P*

Fenkell, George H., Almont, Mich. (June '20) *Trustee '26–'28. Vice-Pres. '30. President '31. Director '31–'32, '38–'41. Honorary M. '40.*

Fletcher, Alfred H., Director, Bureau of Environmental Sanitation, State Dept. of Health, Trenton 7, N.J. (Jan. '36) *P*

Friel, Francis de Sales, Pres. & Treas., Albright & Friel, Inc., 121 S. Broad St., Philadelphia 7, Pa. (Mar. '26) *P*

Gardenhire Bros., Inc., H. C. Gardenhire Jr., Pres., Box 963, Bartow, Fla. (Assoc. M. July '46)

Gearhart, John B., 303 N. Oak St., Centralia, Wash. (Apr. '48)

Girand, James, Vice-Pres., New York Water Service Corp., 90 Broad St., New York 4, N.Y. (Jan. '49)

Greenleaf, John W., Jr., Rader Kanppen Tippetts Eng. Co., 1615 Dupont Bldg., Miami 32, Fla. (Oct. '47) *PR*

Groff, Gilbert, Groff & Clark, Cons. Engrs., 3245 S. Commercial St., Salem, Ore. (July '46) *P*

Hatfield, C. R., Hatfield Eng. Co., 259 Krober Bldg., Albuquerque, N.M. (Oct. '47)

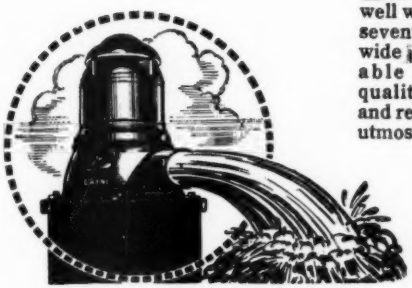
Held, Wilmer O., 2218 W. Clarke St., Milwaukee, Wis. (Jan. '47)

Hougland, V. E., Supt., City of Russell, Box 534, Russell, Kan. (Oct. '45) *MP*

Kleiser, Paul J., Woodridge Park, Route 5, Box 30, Terre Haute, Ind. (Jan. '37) *M*

Laguna Beach County Water Dist., Brayton S. Norton, Gen. Mgr., Box 2287, Laguna Beach, Calif. (Corp. M. May '27) *M*

(Continued on page 34)



LAYNE has been building well water systems for nearly seventy years. Their world wide experience and enviable reputation for high quality, fine workmanship and reliability, guarantees the utmost in satisfaction.

what about

OPERATION COST?

If your city is alarmed over constantly mounting water cost, why not consider the installation of Layne Well Water Units?

With a modern, high efficiency water system your production will be greatly increased with a substantial lowering of monthly operation cost.

In buying Layne Well Water Systems you can be absolutely sure that you are getting the very finest water producing equipment made and that once installed, your units will serve for years and years with little, or perhaps no upkeep expense.

Layne offers a complete service which includes everything from the original surveys to the drilling of wells (if needed), installation of pumps and final testing to your complete satisfaction. No divided responsibility, no waiting for another to finish the job. For further facts, catalogs, etc., address

LAYNE

LAYNE & BOWLER, INC.
General Offices
MEMPHIS 8, TENN.

WELL WATER SYSTEMS

STOP FISH

BY ELECTRONICS

This patented fish control method employs modern electronics in overcoming a serious operating and maintenance problem. Fish of all sizes are kept at a *safe distance* from intake structures, or screens, by the use of an Electronic Control Unit. This equipment, generating special electrical impulses, energizes an electrode system designed and engineered for your particular fish control problem.

The Burkey Electric Fish Screen has been thoroughly proven through years of service in Condensing Water Intakes, Hydroelectric Plants, Water Systems and Industrial Pumping Installations.

DOES NOT STUN OR KILL FISH.

Recommended by State Conservation Officials. Free literature and quotations upon request.

Electric Fish Screen Co.

1130 No. Poinsettia Place, Hollywood 46, Calif.

(*Continued from page 32*)

Lucas, Glenn T., Box 236, Palos Verdes Estates, Calif. (Oct. '43)

McCulley, E. B., Box 112, Alamo, Tex. (Jan. '46) *MP*

Morgan, Alan W., G. R. Locker Co., 1467 Mansfield St., Montreal, Que. (Jan. '47) *P*

Murphy, Alvin R., Jr., 504 Ave. I, N.W., Winter Haven, Fla. (Oct. '47) *MPR*

Oliver, John Craig, 2281 E. Keith Rd., Lynnmour P.O., B.C. (Jan. '47) *M*

Quinn, Robert J., 329 Dixie Drive, Towson 4, Md. (Oct. '45) *P*

Reitz, Cleon, Supt., Water Dept., 624 N. Mechanic, Berrien Springs, Mich. (Jan. '48)

Romine, Harrison E., R.R. 3, Tuscola, Ill. (Apr. '46) *R*

Rowe, Edgar Alan, Lippincott & Rowe, 4826 Orinda Ave., Los Angeles 43, Calif. (Nov. '22)

Salt Lake City Metropolitan Water Dist., Hampton C. Godbe, Exec. Secy., 703 Tribune-Telegram Bldg., Salt Lake City, Utah (Corp. M. Jan. '49)

Sanders, C. A., 416 N. Winnona Drive, Pasadena, Tex. (Oct. '48)

Scott, Rossiter S., 101 W. Monument St., Baltimore 1, Md. (Mar. '22) *P*

Smith, Marlo E., Capt., 1509 Wakefield Pl., New Orleans, La. (Jan. '49)

Snyder, Irving G., 172 Fairview Ave., Stamford, Conn. (Apr. '48)

Stewart, Morgan E., 3105 Telegraph Ave., Berkeley 5, Calif. (Jan. '44) *P*

Tapia-Murillo, Gustavo, 309—11th St., Columbus, Ga. (Jr. M. Oct. '48)

Thompson, Albert T., Jr., 414 Queen Anne Court, San Antonio 9, Tex. (July '48)

Vance, L. S., 5 Hawthorne Hill, Louisville, Ky. (Apr. '38) *Fuller Award '38. M*

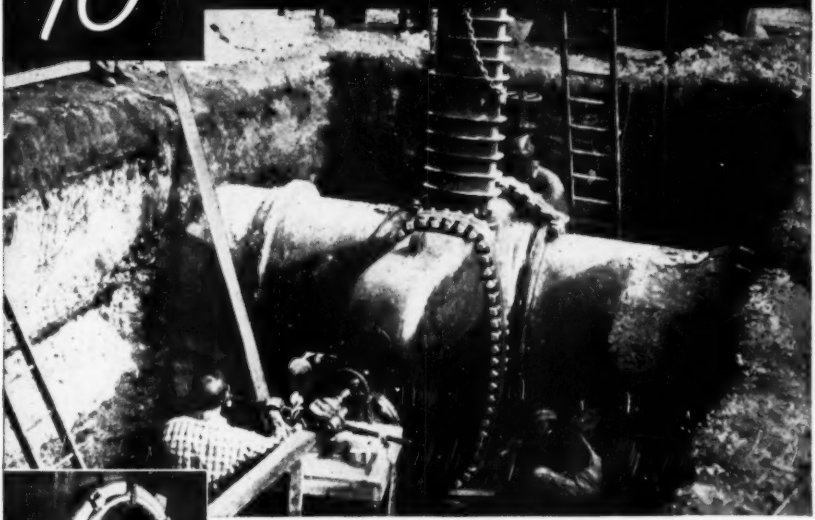
Van Der Lely, J., Shell Caribbean Petroleum Co., Cabimas, Venezuela (Jan. '49)

Wagner, Edmund Glenn, Chief Engr., Inst. of Inter-American Affairs, Caixa Postal 1530, Rio de Janeiro, Brazil (May '42) *MPR*

Walton, Wilbur L., Water Softener Service Co., 231 E. Front St., Wheaton, Ill. (Oct. '45)

Whitehair, Thomas E., Elmhurst Contracting Co., Apdo. 131, Ciudad Trujillo, Dominican Republic (Oct. '45)

48" GATE VALVE INSERTED UNDER PRESSURE
to Avoid Stoppage of Steel Production



Section removed from main

Finished insertion

CUTTING THE MAIN. Illustration shows cutting dome, temporary shut-off valve and permanent valve body in place.

At a large Eastern steel mill uninterrupted production depended upon a thirty year old, 48" cast iron main, carrying sea water used for cooling the furnace jackets. The main was in poor condition — badly corroded and electrolytically pitted.

In order to provide an emergency by-pass in the event of line failure, a gate valve was required. Since the mill could not risk even a momentary shut down, Smith was asked to insert the valve under pressure. Although of unprecedented size, the insertion was completed in four days without interruption of service or reduction in pressure.

*First 48" insertion ever made under pressure. One month later a second 48" gate valve was inserted by Smith for the Water Bureau, Philadelphia, Pa.

29

THE A. P. SMITH MFG. CO.
ESTABLISHED 1896

EAST ORANGE, NEW JERSEY

Cover Pix Nix

To the Editor:

My file of the JOURNAL is in a case immediately behind my desk. I make fairly frequent reference to it. I find the omission of the contents from the front cover to be a considerable inconvenience, and have heard the same complaint from my office mate, Ray A. Riley. I had hoped enough other members would express a similar preference, so that the change restoring the former practice would be made.

The JOURNAL is primarily a reference publication. You don't need the picture to attract buyers, as newsstand periodicals do. Pictures are fine —have a frontispiece or pictorial section if you like. But *please* give us the contents on the cover—whether front or back.

HENRY V. ALDRICH

Sr. Engr., Water Div.
Utility Dept., City Hall
Houston 2, Tex.; June 15, 1949

To the Editor:

I would like to bring to your attention a question which I have been considering since the JOURNAL cover was changed at the first of this year. My personal feeling is that I like the utilitarian cover used last year which gave me a picture of the JOURNAL'S contents rather than a picture chosen for its general interest. I believe it might be desirable to review the question of whether pictures or indexing should appear on the covers.

While discussing this matter I would like to comment that the volume and page numbers and the month and year on the backbones of the volumes are set in type too small to read easily, particularly when the paper is wrinkled as it often is on these edges. It is not easy to find the issue you are looking for when the JOURNALS are in a bookcase which is poorly illuminated.

W. VICTOR WEIR

Pres., St. Louis County Water Co. & Missouri Water Co.
6600 Delmar Blvd.
University City, St. Louis 5, Mo.; May 9, 1949

In thanking readers Aldrich and Weir for their thoughtful comments, we must confess that the present state of consensuslessness among our readers bothers us. With the written vote at two in favor of the present picture cover and now two against it, we remain a little less than certain what some 8,000 others must be thinking. With the decision on a 1950 cover soon to be made, we can well do with some guidance on the continuation of a picture cover, the return to a "contented" one or the adoption of a combination of the two.—ED.

Correctory

To the Editor:

It appears from the "Preliminary Directory of Consultants" included in the June issue of the JOURNAL, that we have been negligent in giving you complete information. We, therefore,

(*Continued on page 38*)

Strain out

two of water's most objectionable characters

IRON AND MANGANESE EASILY REMOVED WITH PERMUTIT WATER CONDITIONING EQUIPMENT

Iron and manganese are extremely objectionable in water supplies for all industrial purposes. They form stains, impart a metallic taste, form clogging deposits, favor bacterial growth, and interfere with practically all wet processing operations!

Pulp and paper mills, chemical plants, textile mills, and tanneries are only a few of the industries that find water low in iron content a necessity. Whatever your individual iron and manganese removal problem may be, Permutit has the equipment you need. For full information about iron removal, whether by base-exchange, aeration, settling and filtration, or by oxidation through manganese zeolites, write to The Permutit Company, Dept. JA-8, 330 West 42nd Street, New York 18, N. Y., or to the Permutit Company of Canada, Ltd., Montreal.

For over 35 years Water Conditioning Headquarters

Permutit®

(*Continued from page 36*)

wish to supply you with the following. . . .

R. G. KINCAID
Burns & McDonnell Engineering Co.
Kansas City, Mo.; June 16, 1949

To the Editor:

I note with regret this morning, that apparently this office failed to return your questionnaire in 1948, covering a directory of consultants, and that as a consequence, our name does not appear in the preliminary directory printed in the June JOURNAL.

To lock the barn door after the cow is stolen, our name should have appeared as follows. . . .

LOUIS E. AYRES
Ayres, Lewis, Norris & May
Ann Arbor, Mich.; June 17, 1949

To the Editor:

The "Preliminary Directory of Consultants" as published in the June issue of the JOURNAL appears to be an excellent idea and should be a valuable contribution to the field of water supply.

I do not recall having received the questionnaire to which you referred but it may easily have been overlooked. However, when additional listings are published, we would appreciate being included. . . .

H. M. GIFFT
Bogema, Gifft & Jenkins
Ithaca, N.Y.; June 20, 1949

To the Editor:

The "Preliminary Directory of Consultants" that appeared in the June JOURNAL was noted with welcome. Now and then we are asked to recommend firms for water supply work. We feel it improper to single out anyone, and would appreciate the chance to furnish a complete list from which the prospective client could make his choice. It might be well for you to reprint the list separately so that copies could be made available for the half-dozen or so cities that query us annually.

There are certain omissions in your dress-rehearsal list which should be rectified by the omittees before the opening performance.

H. E. HUDSON JR.
Head, Engineering Sub-Division
State Water Survey Division, Urbana, Ill.; June 20, 1949

To the Editor:

Just had an opportunity to glance at the preliminary directory of consultants starting on page 567 of the June JOURNAL, and feel that this is a forward step from the consulting engineers' standpoint at least to include such a listing as a regular feature in future issues of the A.W.W.A. Membership Directory.

I feel that the form is very satisfactory and, in compliance with the suggestion in the descriptive article for consultants to correct their own listing, I have the following comments to make in regard to that for Morris Knowles Incorporated. . . .

M. G. MANSFIELD
Morris Knowles Incorporated
Pittsburgh, Pa.; June 21, 1949

To the Editor:

I note your "Preliminary Directory of Consultants" in the June issue of the JOURNAL, and regret that I did not receive your questionnaire or at least have no recollection of having received it. I would much appreciate your forwarding a questionnaire to me, for completion and return to you.

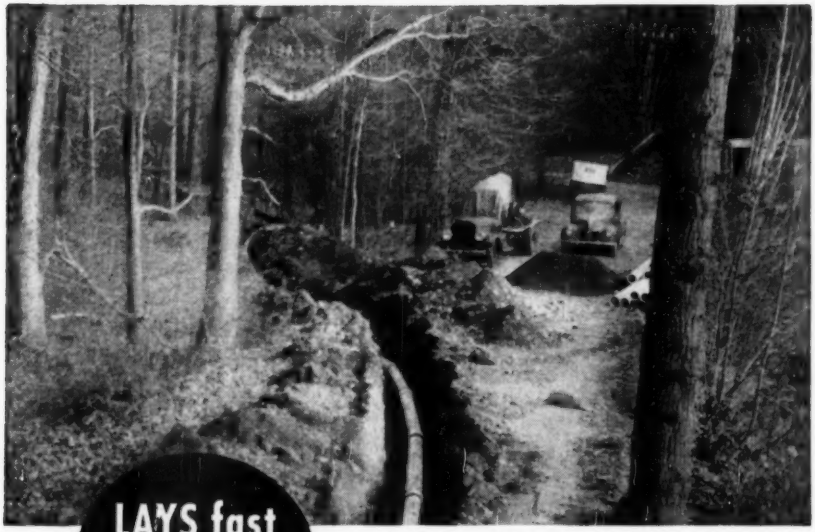
HARVEY F. LUDWIG
Ludwig Brothers
Pasadena, Calif.; June 24, 1949

To the Editor:

We note the "Preliminary Directory of Consultants" on pp. 569 ff. of the June JOURNAL. Inasmuch as there was no way at the time of your compilation for you to have been aware of our existence, we are now wondering if it is impossible to be included in the revised directory. We should be happy to return a questionnaire or we

(*Continued on page 40*)

K&M "Century" ASBESTOS-CEMENT PIPE



LAYS fast
STAYS put
PAYS out

Installation of an 8" Class 150 "Century" Asbestos-Cement Pipe line through wooded area, rocky and uneven terrain.

A revolution has happened in this trench. Ancient and honorable wood pipe has been replaced by K&M "Century" Asbestos-Cement Pipe, the modern water main. Here is a pipe that fits present day engineering ideas. It does not need tonnage and bulk to be strong. Its light weight saves rail, truck and labor costs. It can be handled with a minimum of equipment. It can be laid fast and joined without special skills. It is readily cut and tapped at the job site.

The "Century" flexible couplings at each joint provide for curved lines and changes in grade. In addition, they minimize the effects of traffic vibration and earth settlement.

K&M "Century" Pipe is immune to tuberculation and electrolysis. It is highly resistant to corrosive soils. It actually grows stronger with age. Pumping costs stay where they start, because flow area and frictional resistance remain constant.

You can see why K&M "Century" Asbestos-Cement Pipe does credit to those responsible for its adoption in any community. Write us for full information; we'll answer you promptly.

Nature made Asbestos...
Keasbey & Mattison
has made it serve mankind
since 1873.

K&M best in asbestos ®

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

The Old Way

The New Way

to locate pipe

with the

M-SCOPE

. . . the instrument that takes every bit of guess work out of locating buried pipe, valves, boxes, service stubs, etc. Write for bulletin No. 6.

JOSEPH G. POLLARD CO., Inc.
PIPE LINE EQUIPMENT
New Hyde Park, N. Y.

(Continued from page 38)

can furnish the following as our listing, based on the form used in the JOURNAL. . . .

CARL A. BAYS
Carl A. Bays & Associates
Urbana, Ill.; June 29, 1949

To the Editor:

I was pleased to see the "Preliminary Directory of Consultants" in the June number of JOURNAL. Personally, I believe it is a good move and that as time goes on it will prove a real service to the whole water works fraternity, including consultants, if it is properly used.

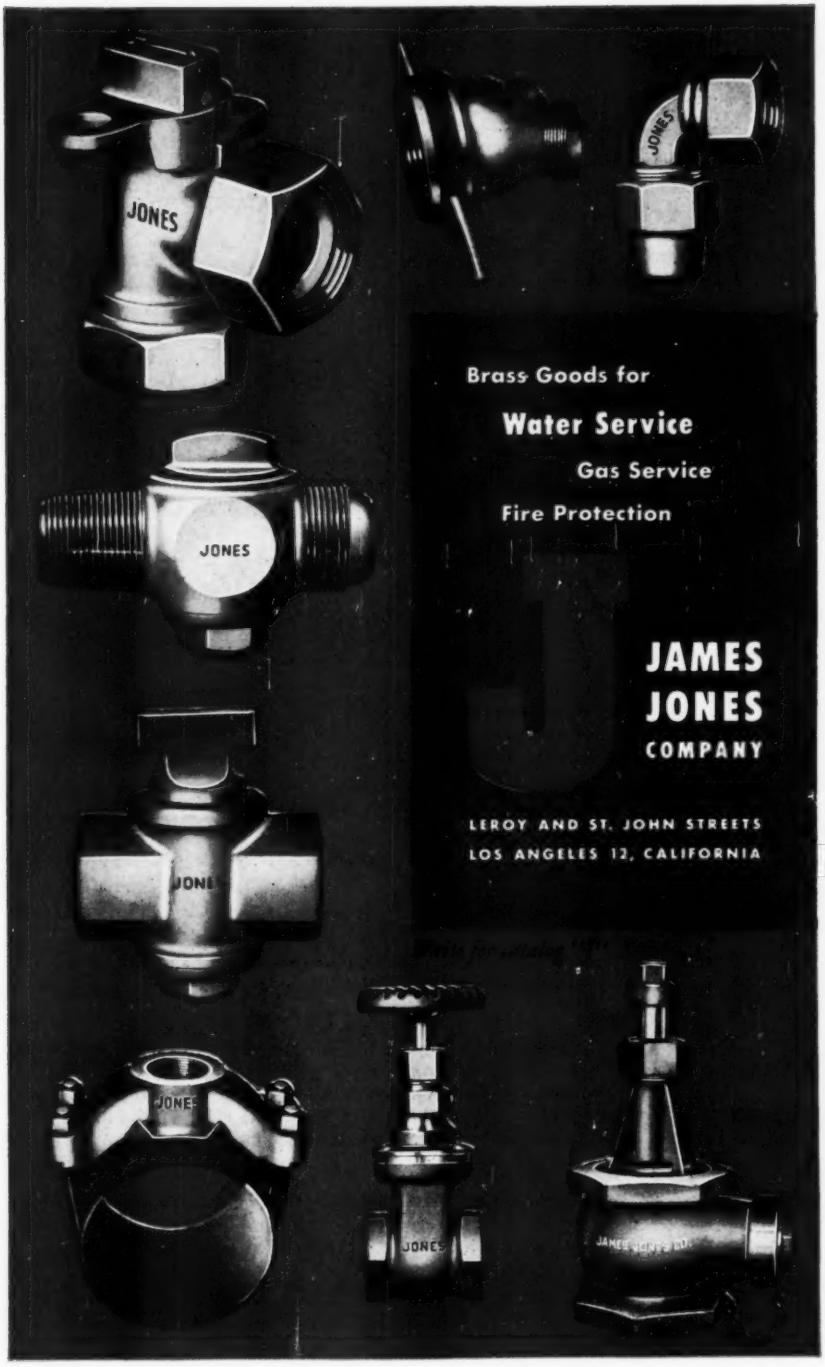
As it is based on those replying to a rather detailed questionnaire which you sent out and as one of the requirements was that principal members of the firm be members of A.W.W.A., it seems to me you have taken reasonable precautions in compiling this list. Doubtless there have been omissions and, perhaps, some of the names listed are borderline cases and not competent to handle large water works projects.

On the other hand, not all projects are large and there certainly is opportunity for the one man office with proper experience and training and in position to handle smaller jobs with perhaps better advantage than the large firms. The possible omissions do not seem to be a serious matter as this is avowedly a preliminary directory and omissions, while unfortunate, are really transitory matters which can be corrected. Borderline firms offer a little more difficulty but here I think dependence must be placed on the municipality or company employing the engineer.

Certainly publication of a list such as this will tend to restrict the entry of highway engineers, electrical engineers and architects without qualifications into the water works field.

My attitude towards this list may be at variance with that of a good many engineers in private practice. Be that

(Continued on page 42)


JONES
JONES
JONES
JONES
JONES
JONES
Brass Goods for
Water Service
Gas Service
Fire Protection
JAMES
JONES
COMPANY
LEROY AND ST. JOHN STREETS
LOS ANGELES 12, CALIFORNIA

(Continued from page 40)

as it may! My attitude is based on actual experience during the ten years I was Chief Engineer of the Pennsylvania State Department of Health. On many occasions we had municipalities write to us in good faith requesting the names of reliable reputable engineers whom they could contact for work which had been ordered by the department. Naturally we wanted to be fair to all and about the best we could do was to tear a sheet from *Engineering News-Record, Water Works Engineering, American City* or other periodicals containing a goodly list of professional cards and write to the town suggesting that they select names of firms in their general vicinity who advertised water works as their specialty and contact them to ascertain their qualifications for the particular job in hand. This did pretty well but it looked like a rather weak reply from a state official department. You doubtless have had many similar requests and the possession of a printed directory such as this, of which you can send out a reprint, will give these people making a sincere request a basis from which to start. I assume of course that in sending out a list you will make it plain that the recipient should make his own investigation as to qualifications of the engineer for the particular job in hand and not try to employ the man who is cheapest even though his qualifications may not be just what is desired.

There are some points concerning the listing of our organization which I shall hope to discuss with you before long, but I did want to get my views on this general matter in your hands as I presume you have received more bricks than bouquets to date.

C. A. EMERSON

Havens & Emerson
New York, N.Y.; June 29, 1949

Above are but some of the comments and criticisms evoked by publication of the "Preliminary Directory of Consultants" in the June JOURNAL *(Vol. 41, p. 567). Although omissions and imperfections were expected, as the introduction and even the title itself indicate, we regret, of course, that there were so many of them.*

In order to repair as many of the defects as possible, as soon as possible, and to fill the evident need for such a list, we now hope to issue a revision sometime before the publication of the 1950 Membership Directory. The information already placed on record with this office, together with the further corrections we hope readers will supply, will be incorporated into the revision. Meanwhile, those who were listed should check their entries for accuracy. It is planned to distribute a revised questionnaire before publication, and every effort will be made to provide as complete a list as possible.
—ED.

Cathodic PROTECTION is More Than Equipment

You can purchase good cathodic protection *equipment* from many reputable manufacturers of anodes, rectifiers, etc. But that's only half the answer to rust and corrosion problems. The rest of it is technical skill in the *application* of cathodic protection equipment and theory.

Electro Rust-Proofing has, at your disposal, a trained staff of corrosion specialists ready to give each problem the individual attention required for successful solution. Why not write today? There's no obligation.

ELECTRO RUST-PROOFING CORP., (N. J.)
BELLEVILLE 9, NEW JERSEY
REPRESENTED IN PRINCIPAL CITIES

E-11

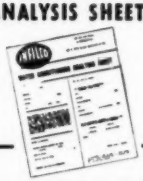
Now.. you can Feed Dry Chemicals with Greater Accuracy and Efficiency

Install the Sturdy, Compact TYPE E4 Dry Chemical Feeder

INFILCO'S new TYPE E4 Feeder brings a new, high degree of *sustained* accuracy and efficiency to the feeding of dry chemicals. It represents more than 25 years of constant development and perfection .. 25 years of *experience* in the design and manufacture of Chemical Feeding Equipment for water purification and sewage or waste treatment operations. You can expect the "E4" to feed many millions of pounds of chemicals with *unvarying* accuracy and a minimum of upkeep cost. Adjusting the feed rate is a quick, easy job. Simple, sturdy and compact, this *better* Feeder will give dependable, *dust-free* service for years. Made for either constant rate or automatic proportional feed operation. May we send you complete information?

FREE LABORATORY SERVICE.. SEND FOR THIS WATER CONDITIONING ANALYSIS SHEET!

Get our Water Analysis Sheet, then fill in and return it with a sample. You will receive our laboratory analysis and report promptly. A valuable INFILCO CHEMICAL CALCULATOR slide rule sent FREE to all who return it. There's no cost or obligation.



INFILCO

• BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1894

INFILCO INC.

SALES OFFICES IN TWENTY SIX PRINCIPAL CITIES

WORLD'S LEADING MANUFACTURERS OF WATER CONDITIONING AND WASTE TREATING EQUIPMENT

Condensation

Key: In the reference to the publication in which the abstracted article appears, **39**:473 (May '47) indicates volume 39, page 473, issue dated May 1947. If the publication is paged by the issue, **39**:5:1 (May '47) indicates volume 39, number 5, page 1, issue dated May 1947. Abbreviations following an abstract indicate that it was taken, by permission, from one of the following periodicals: *B.H.—Bulletin of Hygiene (Great Britain); C. A.—Chemical Abstracts; I. M.—Institute of Metals (Great Britain); P.H.E.A.—Public Health Engineering Abstracts; W.P.R.—Water Pollution Research (Great Britain).*

DISTRIBUTION SYSTEMS

Cleaning Gas and Water Mains. A. G. HOLTAM. The Engr. (Gt. Br.) **186**:142 (Aug. 6, '48). Equip. consists of motorized thrusting and rotating machine, flexible steel rods, extensible in manner similar to drain rods but fitted with special couplings, scraper heads of various types, and small motor water pump. In main without junctions, section of about 160–200 yd. can be dealt with in one operation. Two excavations made, about 4′ cut out of pipe at each point and live ends temporarily plugged. At lower point, rotating machine arranged facing open pipe and pump placed with intake in small sump at bottom of excavation. At higher point, 1″ pipe screwed into main and connected by hose to convenient water supply. Scraper head screwed to first section of flexible steel rods and head thrust into open end of main., other end of rods being fixed in rotating machine. Motor rotates rod and head at 700–2000 rpm., as desired. At same time machine moves forward gently, rods being fitted periodically, until head appears at higher point. Head and rods then spun backwards by machine and withdrawn from main. When machine started, water turned on and flows down main carrying matter removed into lower excavation, whence it is pumped away. Time from starting to appearance of head 160 yd. away about 45 min. Costs vary with circumstances; 2640 yd. of 3″ pipe costs 4s 4d per yd., and 2297 yd. of 5″ and 6″ costs 4s. 1d. per yd. Except for cost of collars and pieces of replacement pipe, diam. makes but little difference in overall cost.—*H. E. Babbitt.*

Trench Excavation and Main Laying Using Mechanical Plant. T. B. SMITH. Wtr. & Wtr. Eng. (Gt. Br.), **51**:154, 216 (April, May '48). Kinds of plant which can be utilized in trench excavation and main laying include: [1] crawler excavator, fitted with drag shovel (back-acting) attachment or dragline attachment; [2] ditcher, fitted with wheel type or ladder type bucket arm; [3] tractors with digging and other attachments; [4] mobile air compressors and their attachments; and [5] power rammers. Crawler excavators are mobile digging machines, consisting of operator's cabin containing power unit and controls, mounted on crawler tracks about which whole superstructure can revolve. On commencement of digging with drag shovel, machine placed over trench centerline with tracks symmetrically placed over it. Boom raised and digging arm swung out and away from machine, so that when boom lowered teeth of bucket bite into ground over starting point. Dragline has much longer boom of lattice construction, and bucket held by cables only. Bucket size of crawler excavators varies from $\frac{1}{4}$ to 35 cu.yd. in capacity. Following gives basis for comparison of capabilities of different sizes of drag shovel:

(Continued on page 46)

...and that was the problem at Rockford

Water from some of the wells of the Rockford, Ill. municipal system contains as much as 0.9 ppm of dissolved iron, but in Well #5 the iron runs an average of 2 ppm, which makes this well unusable.

So high a concentration of iron means certain trouble, so this well required either an iron removal plant—or Threshold Treatment with Calgon. Threshold Treatment was adopted and with complete success. With this treatment there has been no trouble with the water, no complaints from the customers, in spite of the fact that break-point chlorination is employed.

Threshold Treatment with Calgon has been so satisfactory that it has been extended to a second well, where iron concentration averages 0.8 ppm. Here again it has been entirely successful, and extension to still another well is now under consideration.

Rockford is only one of many hundred communities of all sizes where Threshold Treatment with Calgon is used to prevent scale, control corrosion, eliminate "red water" or stabilize water following lime softening.

Calgon representatives will be glad to discuss the use of Threshold Treatment in your plant.

*T. M. Reg. U. S. Pat. Off.

HAGAN HALL BUROMIN CALGON

calgon, inc.

A SUBSIDIARY OF HAGAN CORPORATION

HAGAN BUILDING PITTSBURGH 30, PA.

Which of These Technical Bulletins Can You Use?

Whether you are a water plant operator or engineer, these SOLVAY Technical Bulletins should be in your reference library. The answers to many problems concerning water treatment, the handling and storage of liquid chlorine, and water analysis can be found in these three bulletins.

This authentic material and information is the result of many years of research and study. It can be of great value in helping to clear up technical water plant problems; it is also an excellent reference material. Get any one or all three of these important books now—there's no cost or obligation. Simply fill in and mail the coupon for these SOLVAY Technical Bulletins.

SOLVAY

LIQUID CHLORINE
SODA ASH

SOLVAY SALES DIVISION,
Allied Chemical & Dye Corporation
40 Rector Street, New York 6, N.Y.

Please send me, without obligation, the SOLVAY Technical Bulletins I have checked below.

☐ Bulletin No. 7—Liquid Chlorine
☐ Bulletin No. 8—Alkalies and Chlorine in the Treatment of Municipal and Industrial Wastes
☐ Bulletin No. 11—Water Analysis

Name _____

Company _____

Address _____

City _____ State _____ JAW-8

(*Continued from page 44*)

Size *cu.yd.*	Output *cu.yd./hr.*	Depth of Trench *ft.*	Width of Trench *ft.*
¾	30	up to 12	2–3
½	40	up to 16	2–3
1	50	up to 18	2–4

Ditcher or trencher fastest means of trench digging and undoubtedly ideal tool for water main excavation. Ditchers are continuous bucket diggers consisting essentially of power unit and controls mounted on crawler tracks. Two main types available: with boom carrying wheel on which buckets revolve and with boom forming ladder sloped at required angle into trench. One of greatest advantages of ditcher over drag shovel is when operating in ground where sides of trench are liable to fall in; "sawing" action of buckets is less likely to disturb ground and cause slips than heavy shock action of drag shovel. Best heavy tractors and most attachments of American manufacture. Tractor attachments in most common use: front attachments—bulldozer, angledozer and tiltdozer blade, high-powered winch for exerting line pull and rooter blades for scarifing hard surfaces; rear attachments—power control unit for operating towed attachments described below, high-powered winch, dragline, clamshell and crane lifting booms; towed attachments—scraper for surface excavation in cuts up to 9″ deep (either cable-operated from power control unit or hydraulically controlled), rooter for heavy scarifying, crane controlled by power control unit, blade grader for surface leveling and grading, and dump trucks made with bottom discharges in sizes up to 13 cu.yd. In addition to end attachments, side boom used. Pipes hauled to site by tractors and low loaders are unloaded and laid in trench by tractors fitted with side booms. Mobile air compressors and attachments essential aids to excavation. Great variety of tools available for attachment, but only 5 normally used in trenching: paving breaker, digger, rammer, calk-

(*Continued on page 48*)

INTRODUCING THE W&T MERCHEN SCALE FEEDER

FOR WATER AND SEWAGE TREATMENT CHEMICALS

Wallace & Tiernan is proud to offer this machine, proven by nine years' experience in the flour, grain, and chemical industries, to those water works operators who desire maximum accuracy, simplicity, and dependability in dry chemical feeding equipment.

WHAT THE FEEDER DOES—Feeds continuously and accurately at rate selected by operator—Scale beam calibrated in pounds per unit of time—Once rate is chosen, feeder automatically adjusts itself to that rate, thus eliminates calibration regardless of material fed — Quantity of chemical fed recorded on tally unit.

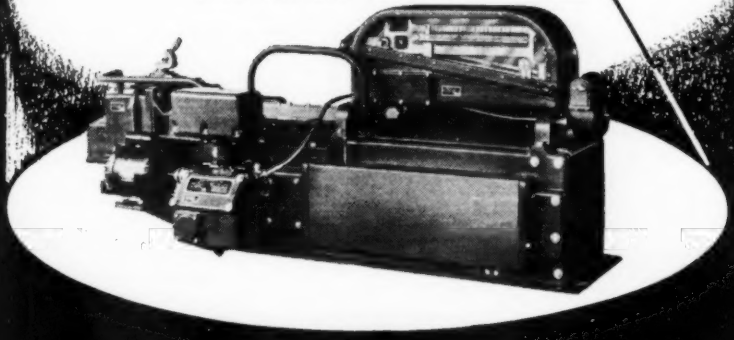
HOW IT WORKS—Feeds BY WEIGHT using constant speed belt drive with variable speed screw feed section, thus eliminates inherent inaccuracy of variable belt speed method.

ADVANTAGES—Totally enclosed motors, oil seals on all bearings, oil baths for drive gears, dust-tight beam enclosure —Provides minimum maintenance and insures high accuracy of feeder for life of machine—Adaptable to program or proportional control—Alarm systems can be added—Wide range up to 2 cu. ft./min.—Extreme accuracy provides maximum economy in feeding of chemicals.

Communicate with your nearest W&T representative and he will gladly furnish you with complete information on the W&T Merchen Scale Feeder.

WALLACE & TIERNAN COMPANY, INC. M-12

CHLORINE AND CHEMICAL CONTROL EQUIPMENT
NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES



(*Continued from page 46*)

ing tool and timber driver. With mobile plant, inspection and attention more essential than with static machinery. Extra care required in planning. Field and office organizations must be maintained to assure availability of men and materials in sufficient quantity at correct time.—*H. E. Babbitt.*

Domestic Water Supply Systems, With Special Reference to Burst Pipes. H. W. WALTERS. Wtr. & Wtr. Eng. (Gt. Br.), **51**:211 (May '48). Water supply conveyed through pipes to every home is one of aims of modern civilization. Advantages are obvious but to some extent disadvantages are lost sight of except when outstanding event, such as widespread outbreak of typhoid fever, or great "freezeup" reminds people of their existence. Many may not be well informed about trouble from other plumbing defects. They include: [1] uncovered storage cisterns; [2] inadequate supply at cold taps, for which contributory causes are inadequate piping, incrustation and corrosion; [3] inadequate supply at hot taps, for similar reasons; [4] corrosion of galvanized hot-water storage tanks; [5] incorrect selection of ball valves in relation to pressure; [6] badly designed or maintained drawoff taps or ball valves; [7] use of washers of incorrect material and incorrect size or washers incorrectly housed; [8] flushing cisterns operating noisily on account of inferior design and finish; [9] piping and cisterns so fixed or located that repairs, replacements and cleaning are difficult and expensive; and [10] systems which give airlock trouble in refilling, commonly arising with piping so arranged that it

(*Continued on page 50*)

There are Kupferle Fire Hydrants to fit every need. Full lines in a complete size range for public and private installations. Before making any decision, get the Kupferle Specification sheets.
JOHN C. KUPFERLE FOUNDRY CO.
ST. LOUIS
KUPFERLE
FIRE HYDRANTS

3 *Money, Time and Labor Saving Features of*

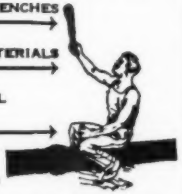
UNIVERSAL*

CAST IRON PIPE

LAID WITH ONLY WRENCHES

NO CAULKING MATERIALS

NO GASKETS. NO BELL HOLES TO DIG.



*REG. U.S. PAT. OFF.

For water supply, fire protection systems, sewage disposal systems, industrial, and irrigation. Flexible.

Dept. C
THE CENTRAL FOUNDRY COMPANY
386 FOURTH AVENUE, NEW YORK 16, N. Y.

Gentlemen: Send us information and catalog on UNIVERSAL CAST IRON PIPE.

NAME_____

STREET_____

CITY_____

CENTRILINE *protects the new* HAVANA AQUEDUCT

▶▶ HAVANA'S BRAND NEW WELDED-STEEL AQUEDUCT HAS BEEN PERMANENTLY PROTECTED FROM TUBERCULATION AND LEAKAGE BY A THIN, DENSE CEMENT LINING PLACED BY THE CENTRILINE PROCESS.

Heavy rains made tractors useless—but Centrilining was completed in record time.

The new pipe line—68" in diameter and 28,809' long—was built for the City of Havana by M. A. González del Valle, General Contractor. The steel pipe was fabricated and installed by Compania de Ingenieria Morgran, S. A. of Havana. Because it is a vital link in Havana's new system it was lined in place with centrifugally applied cement mortar.

This protective cement mortar lining will more than pay for itself within a few years through sustained carrying capacity and low pumping costs.

▶▶▶ Do you want the complete facts on Centrilining? Send for 28-page illustrated bulletin.

CENTRILINE CORPORATION

140 CEDAR STREET • NEW YORK 6, N. Y.

CEMENT MORTAR LININGS FOR WATER MAINS

CENTRIFUGALLY APPLIED
in strict conformity
with A.W.W.A. Specifications

(*Continued from page 48*)

cannot be emptied. In London, if dwelling house without water supply, this alone, in law, renders premises unfit for habitation. Water utilities empowered to make and enforce bylaws for preventing waste, undue consumption, misuse and contamination of domestic water supplies. Scope of bylaws of Metropolitan Water Board comprehensive and if strictly enforced would go far to prevent unfortunate happenings. Enforcement of bylaws in new buildings should not present difficulty. Enforcement in respect to existing installations and extensions thereto encounters difficulties. On grounds of public health, alternative procedure must be sought. Faulty water supply systems create many public health problems. Every few years large numbers of domestic water supply systems frozen, leaving houses without water. Occupiers obtain water from emergency sources which may not be satisfactory from hygienic point of view. Further trouble arises when thaw reveals that pipes and tanks have burst. Unsanitary conditions resulting from frozen pipes are concern of sanitary authorities. Unfortunately they are impotent for they cannot compel owner to amend pipes, cisterns, etc. This is in direct contrast to alterations made in regard to pipes which carry off waste water. Bylaws of Metropolitan Water Board require any person desiring to extend supply of water to give board 3 days' notice of intention. This implies that work will be examined. Officer should not pass alterations until satisfied that frost precautions observed. There is need for something to be done on premises where existing installations do not comply with bylaws. Objections on grounds of expense, inconvenience, and shortage of labor and materials not valid. Precaution against frost wise investment. Shortage of labor and materials will not make work impossible. Life of average brick house reckoned to be about 100 yr. If no action taken with respect to existing installations, problem will remain for century.—*H. E. Babbitt.*

Bursting of Water Mains. ANON. Surveyor. (Gt. Br.) **107**:341 (July 2, '48). 36-in. main, laid in '24 from Westminster Bridge Rd. to Tooley St. to withstand pressure of 600′, has length of 3100 yd. Normal pressure about 150′, never exceeded. There have been 6 fractures, all but one 440 yd. in length. After fracture, condition of metal found good. Subsequent examn. of about 1700 yd. of bed showed condition of pipe excellent. Subsoil found very solid. Latest report states that subsequent to break disturbance of surrounding ground by escaping water destroys all evidence of extraneous conditions, and settlement of pipe or interference with support as result of activities of other authorities not always obvious after break. On other hand, weakness of iron or corrosion generally easy to detect. In main in question, causes of burst are obscure.—*H. E. Babbitt.*

The Search for Leaks in a Destroyed Distribution System. WILLI GUSCHEL. Gas u. Wasser. (Ger.) **89**:4: 123 ('48). Breslau 85% destroyed with over 1000 breaks in distribution system, not counting those to house connections. Connections to destroyed houses closed. Leaks in distribution system determined by losses in pressure with known pumpage. Pressure measured at hydrants starting at pumping plant. Electrical acoustical apparatus could be used very little, owing to outside noises. Measurements of flow with Pitot tubes and with inserted meters helped to localize greater losses. Studies have to be made systematically over whole distribution system and helped greatly by complete detailed maps of

(*Continued on page 52*)

"Koppers will handle the coating job from *start to finish.*"

● On water and sewage projects, it's sound, long-range planning to turn the job of protecting the steel pipe over to Koppers Contract Department. Koppers' trained protection specialists will handle the job from start to finish.

Koppers furnishes skilled workmen, competent supervision and special equipment to coat your pipe lines inside and out with Koppers Bitumastic* Enamel.

This *permanent* protective coating is processed from coal-tar pitch, a substance that has outstanding records in the battle against corrosion. Inside the pipe, the Bitumastic spun lining prevents rust and tuberculation and guards against the attack of sewage gases and acids. The Bitumastic exterior coating protects the pipe against moisture, corrosive soil and electrochemical reaction.

For long-lasting protection against corrosion . . . for a job done right from start to finish . . . call on Koppers Contract Department.

*T. M. Reg. U. S. Pat. Off.

KOPPERS COMPANY, INC., Dept. 814T, Pittsburgh 19, Pa.

KOPPERS BITUMASTIC ENAMELS

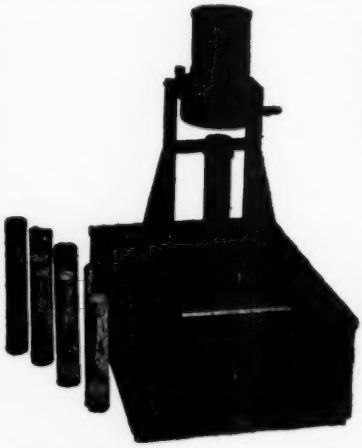
(*Continued from page 50*)

system. In 6 weeks losses could be reduced from 12.5 to 5.5 mgd.—*Max Suter.*

Location of Water Mains. H. WILLIAMSON. Surveyor (Gt. Br.), **107**: 207 (Apr. 23, '48). Discussion of report by joint committee of Institutions of Civil and of Municipal Engrs. Adoption of recommendations has been disappointing. Obstacles which render adoption impossible include: small width of sidewalks; curb type gutters on paths; sewers in pathways; insufficient space for hydrants; and insufficient space for gate valves and valve boxes. In view of need for conserving cast iron, use of pipes and specials should be cut to min., but layout of modern housing estates prevents it. Estd. that 25% more specials now required as compared with prewar layouts. In junction of major and secondary roads, if angles arranged so that std. bends could be utilized would facilitate laying of service mains. Common type of dead-end road terminates in circular turnabout, making it uneconomical to lay services in sidewalk. To lay short lengths of main just to serve houses immediately under constr. instead of servicing whole estate may be uneconomical, but with acute labor shortage large utility has no alternative but to adopt this method.—*H. E. Babbitt.*

Calculation of Water Distribution Net in Houses. A. DE SALDELER. Tech. Sanit. (Fr.) **43**:135 (Nov.–Dec. '48). Factors to be considered: pipe diam., nature of metal, roughness of walls (including incrustations), volume (output) and type of distribution net (curves, sections, etc.). Tables

(*Continued on page 54*)



LUMETRON

Photoelectric Colorimeter Mod. 450 for Nessler Tubes

A new photoelectric instrument of high accuracy for the measurement of color and turbidity as well as for all analytical colorimetric tests in the sanitary examination of potable and purified water.

- Turbidity tests in terms of APHA (ppm) scale.
- Color tests in terms of APHA (mg Pt) scale.
- Suited for determination of ammonia nitrogen, nitrate, nitrite, and for all other colorimetric tests according to APHA "Standard Methods."

Operates with all "low-form" Nessler tubes 32 mm O.D., 200 mm high. Requires no matched sets of tubes.

LUMETRON Mod. 450 eliminates the uncertainties of visual matching methods. It requires no permanent color standards and furnishes reproducible results independent of individual judgment and of light conditions.

Write for literature to

PHOTOVOLT CORP.

95 Madison Ave. **New York 16, N. Y.**

A new edition

— JUST OFF THE PRESS!

20 pages of useful information on elevated water storage

WRITE FOR YOUR FREE COPY TODAY

. . . no obligation of any kind

Tear off along dotted lines

Gentlemen: Please send me a copy of "Modern Water Storage"

NAME _____

Title _____

Business Address _____

PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH . . . . . 3424 Neville Island
NEW YORK . . Room 921, 270 Broadway
CHICAGO, 1228 First National Bank Bldg.
DES MOINES . . . . . 925 Tuttle Street
DALLAS . . . . 1229 Praetorian Building
SEATTLE . . . . . 932 Lane Street
SANTA CLARA, CAL. . . 631 Alviso Road

(*Continued from page 52*)

present values per meter of pipe, flows and diameters. Coefficients calculated by Lang's formula. Practical applications shown.—*W. Rudolfs.*

BRITISH SUPPLIES

A Description of the Liverpool Corporation Water Supply Undertaking—1847–1947. ANON. Wtr. & Wtr. Eng. (Gt. Br.), **51**:202 (May '48). At beginning of 18th century sources of water supply springs and shallow wells. About 1694 grant made to company to supply water from springs in Bootle. In 1799 company incorporated to supply water from certain streams in parish of Bootle. Supply given by two competing companies inadequate. In 1843 highway commissioners promoted bill which resulted in sinking of deep well at Green Lane, construction of reservoir at Kensington and laying of supply mains. In 1846 Hawksley prepared Rivington Pike Scheme, adopted by council in 1847. In same year council empowered to purchase 2 water companies. After passage of Act of 1847, opposition to Rivington Scheme arose from advocates of wells. When Rivington water first distributed in 1857, its slightly yellow color so distasteful it was decided to continue to use principal wells and mix waters. Objectionable color disappeared as filter beds matured. Drought of 1864 so affected watershed yield that in 1865 not possible to continue constant supply. In 1847 compensation water purchased to make additional 1.835 mgd.(Imp.) available. In 1859 meter system of waste detection established and still in use. Vyrnwy scheme adopted by council in 1879; work commenced in July 1881; and in July 1891 water first sent through Vyrnwy Aqueduct. In 1897 systematic bacteriological and chemical analyses of water commenced. Scheme of afforestation adopted. In '02 work began on second pipeline from Vyrnwy. From '10 to '14 avg. increase in demand for water at rate of 1 mgd. per annum. When war came demands increased to such extent that in '19 construction of third pipeline authorized, but work on this not commenced until '26. During World War II demands greatly increased. In '41 additional 42" steel trunk main laid. In '47 work commenced on section of 4th pipeline and trial boreholes made for additional storage reservoir at Prescot. Present sources of supply: 2 Liverpool wells and Rivington and Vyrnwy gravitation scheme. Both Rivington and Vyrnwy Aqueducts terminate at Prescot where water received into 3 open storage reservoirs. In addition to public water rate of 6d per pound of rateable value, "water rent" levied on all property supplied with water for domestic purposes. Capital expenditure to Mar. 31, '47, £9,005,133. To safeguard purity of water, strict sanitary code applied on gathering grounds. Water treatment consists of primary storage in open reservoirs, screening by copper gauze screens, slow sand filtration and sterilization by chloramine. Avg. consumption of water in '47:

Purpose	*mgd.*(Imp.)
Domestic	27.652
Trade	13.680
Ships	0.715
Institutions	0.404
Sundry	1.418
Public	0.679
Baths and washhouses	0.405
Fires	0.015

Quantity supplied outside of Liverpool 74.695 mgd.(Imp.) and quantities derived from various sources were: wells, 2.652; Rivington, 20.208; Vyrnwy, 51.835 mgd.(Imp.)—*H. E. Babbitt.*

Progress Report on Liverpool's Fourth Vyrnwy Pipeline. ANON. Wtr. & Wtr. Eng. (Gt. Br.), **51**:364 (Aug. '48). Steady progress being made. Total cost estimated as £2,500,000. Contract for section estimated to cost

(*Continued on page 56*)

WHY FAMOUS

RENSSELAER

DOUBLE DISC

GATE VALVES

open easier... seal tighter!

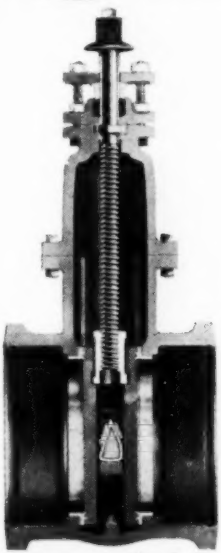
IN OPENING, THE THICK (A) SIDE OF THE STEM NUT LIFTS THE GATE ON ONE SIDE FIRST, MECHANICALLY BREAKING SEAL

GATE ON SHORT SIDE (B) OF WEDGE IS PULLED FIRST, LOOSENS EASILY. IN CLOSING, LONG SIDE (C) OF WEDGE CAUSES POWERFUL SEATING FORCE ON THAT SIDE.

The principles of the long Wedge for greater seating power and the short Wedge for easier unseating apply to RenSSelaer Valves in sizes 10" and larger. But in ALL sizes of these famous Valves, ONE gate is ALWAYS lifted FIRST, mechanically releasing the wedges, so opening is positive. Wedging action does not seat gates until they are in *"fully closed"* position, so sliding frictional wear is minimized.

But ease of operation is only one feature of RenSSelaer Valves. SOLID BRONZE is used liberally throughout – in stems, stem nuts, wedges, seat and gate rings, glands and stuffing box nuts. Castings are high tensile strength corrosion-resistant iron. INTERCHANGEABILITY of parts insures low maintenance cost. Thousands in perfect service for over 65 years.

Experienced Field Representatives are at your call to bring you the benefit of RenSSelaer experience in Valves AND Hydrants. Their service puts you under no obligation. Call our nearest office.



Above cross-section shows 2-sided wedge on valves 10" and larger

LEADERSHIP FOR OVER 65 YEARS

RENSSELAER

Gate Valves • Square Bottom Valves • Tapping Valves and Sleeves
Hydrants • Check Valves • Air Release Valves

RENSSELAER VALVE COMPANY • TROY, N. Y.

Division of Neptune Meter Company

(*Continued from page 54*)

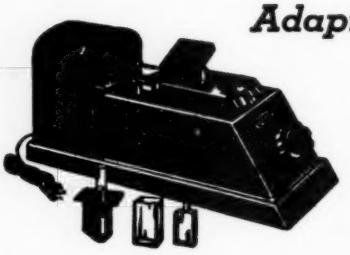
£310,000 expected to finish by end of '48. Second section, now well under construction, with estimated cost of £296,000, will extend from Oswestry towards Liverpool. Last year water committee had £202,000 capital expenditure. During current year they have made provision for capital expenditure of £466,000. With exception of Hirnant and Cynynion Tunnel, total distance of 4 mi., aqueduct will consist of 4 lines of pipe, each 64 mi. long, 3 of which have been completed and work on 4th commenced in April '47. Aqueduct divided into 6 sections by balancing reservoirs. Special feature in construction is method for jointing pipes, by circumferential *in situ* internal electrically welded sleeve joints. As each subsection completed, it will be connected to existing connections and brought into use.—*H. E. Babbitt.*

Proposed Reservoir in the Enborne Valley for the Metropolitan Water Board. ANON. Wtr. & Wtr. Eng. (Gt. Br.), **51**:324 (July '48). Scheme consists of three parts: intakes and pumping station on Thames at Pangbourne, pipeline from pumping station to reservoir, and dam near Brimpton across Enborne Valley. Catchment area and runoff of Enborne R. small. Water to be impounded to be drawn from Thames. Pipeline will be 60″ bore, 9 mi. long. Capacity of reservoir will be 55,000 mil.gal. (Imp.) with top water level 300′ above sea. During dry summer water from reservoir will be discharged down pipelines into Thames and will flow down river to intakes in Hampton area. Dam will probably be earth embankment with clay core. Greatest depth will be about 100′ and length about 1 mi. Thames water

(*Continued on page 58*)

KLETT SUMMERSON
ELECTRIC PHOTOMETER

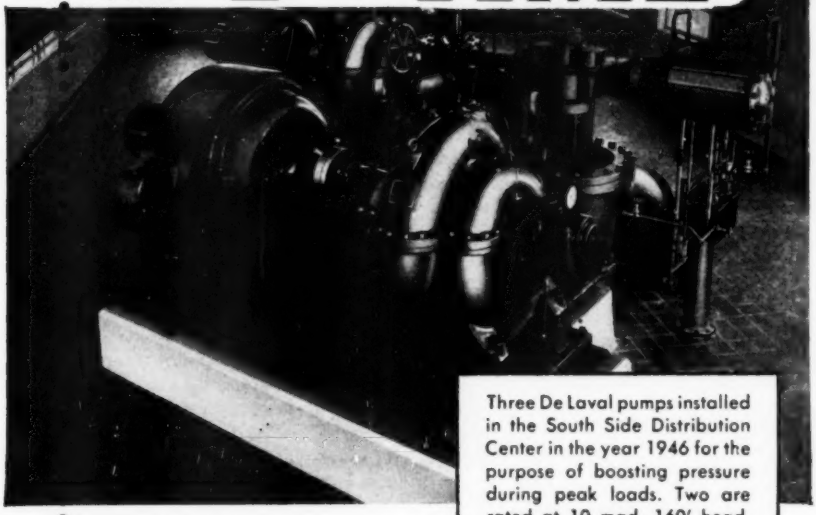
Adaptable for Use in Water Analysis



Can be used for any determination in which color or turbidity can be developed in proportion to substance to be determined

KLETT MANUFACTURING CO.
179 EAST 87th STREET • NEW YORK, N. Y.

FOR THE 7th TIME



Three De Laval pumps installed in the South Side Distribution Center in the year 1946 for the purpose of boosting pressure during peak loads. Two are rated at 10 mgd, 160' head, the third at 15 mgd, 160' head.

FLINT WILL INSTALL DE LAVAL PUMPS TO MEET INCREASED WATER DEMANDS

Seven times in a row . . . 1918, 1921, 1923, 1924, 1930, 1946, and now in 1949 the City of Flint, Michigan will install De Laval pumps to satisfy an ever increasing demand for water. Four low lift and two high lift pumps will be installed in Pumping Station No. 3 later this year and they will give the City of Flint a total capacity of 352 mgd . . . all handled by De Laval pumps.

Here, as in over 78 per cent of America's cities, De Laval pumps have insured complete dependability and high sustained efficiency, year after year. When you are ready to install additional pumping capacity, specify DE LAVAL.

Send for Catalog 10-8-JA

DE LAVAL

DE LAVAL STEAM TURBINE CO., TRENTON 2, N. J.

TURBINES • HELICAL GEARS • CENTRIFUGAL BLOWERS AND COMPRESSORS
CENTRIFUGAL PUMPS • WORM GEAR SPEED REDUCERS • IMO OIL PUMPS

WW-8

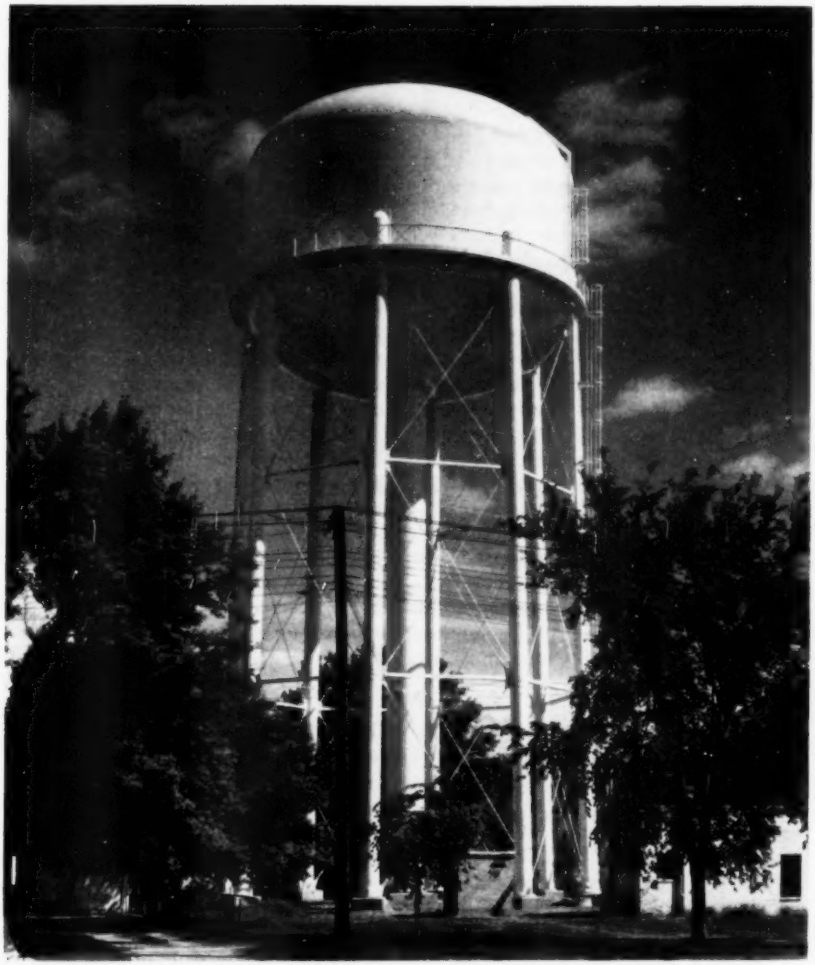
(*Continued from page 56*)

notoriously difficult to treat on account of algae blocking filter beds. Large area of shallow water will increase this difficulty. Some form of erosion protection to embankment will be necessary. If catchment area of Enborne not sterilized by removal of inhabitants, arrangements must be made for disposal of sewage downstream of dam. Catchment area largely given over to farming, and population within reservoir area more than 1,500, with 8,000 in catchment area. Land values will be high and opposition will find influential backing. Reasons given by board for substitution of Enborne scheme for reservoirs at Walton, Wraysbury and Datchet: necessary to provide more storage than anticipated two years ago; Enborne scheme will provide more than three times combined storage of Walton, Wraysbury and Datchet; and total cost will be smaller. Enborne scheme chosen as best of four possibilities: [1] sea water from south coast—board now obliged to allow 170 mgd. to pass down Thames over Teddington weir, below board's intakes; scheme is to pump water from sea into Thames above Teddington weir and take equivalent amount of fresh water from river; [2] supply from Great Ouse—board proposed to pump water from Great Ouse into Lee Valley, proposal probably including balancing reservoir between two valleys; [3] supply from Wales—proposal to impound one of tributaries of Wye (Irfon) and convey water about 150 mi. to London. Enborne scheme will not relieve flooding of Thames Valley. Once reservoir filled, no help will be given in reducing flood discharge. Board intends to apply for authority by orders under Water Acts of '45 and '48, and not as hitherto, by promoting parliamentary bill.—*H. E. Babbitt.*

London's New Reservoirs. Dramatic Change of Policy. Anon. Wtr. & Wtr. Eng. (Gt. Br.), **51**:272 (June '48). By Metropolitan Water Board Act of '46 board empowered to acquire land for large storage reservoirs at Wraysbury and Datchet. Construction of Walton reservoir, begun in '37, remains about half finished. Board does not now intend to proceed with reservoirs at Wraysbury and Datchet and intends to abandon partly finished Walton reservoir. Report to board, presented by work committee states: Provision hitherto contemplated for meeting increasing demand is inadequate and works already planned would, even if constructed and in use today, be insufficient to satisfy requirements when flow in Thames and Lee R. abnormally low; necessary either to provide storage additional to that hitherto envisaged to insure adequate storage available for second dry summer, or to make special arrangements to replenish reservoirs to max. capac. during dry winter; conclusion reached that most economical and practical proposal would be to construct impounding reservoir in Enborne Valley, few miles southwest of Reading, connected by conduits to intake and pumping station on Thames at Pangbourne. Enborne reservoir would cover area of approximately 9 sq.mi. and would provide more than 3 times combined capac. of proposed reservoirs at Walton, Wraysbury and Datchet. Raw water conduit should be constructed in deep-level tunnel from Thames to Lee Valley with additional intake and pumping station on Thames. All these new works now matter of some urgency. Reason given for sudden change in policy: sharp upward trend in total demand evident since end of war.—*H. E. Babbitt.*

Report of the Departmental Committee on Greater London Water Supplies. Wtr. & Wtr. Eng. (Gt. Br.), **51**:402 (Sept. '48). Committee

(*Continued on page 60*)



Horton Welded Elevated Tank

The City of Moorhead, Minn., installed the 500,000-gal. welded elevated tank shown above to help maintain an average pressure of 43 lbs. per sq. in. in its water distribution system. The structure is 83 ft. to the bottom. Write our nearest office for estimating figures when planning waterworks improvements.

CHICAGO BRIDGE & IRON COMPANY

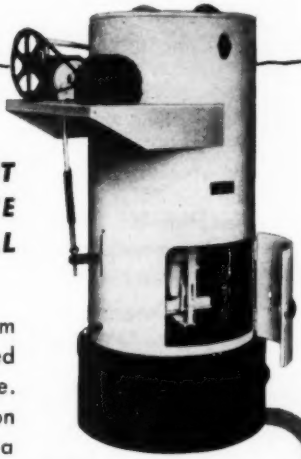
BIRMINGHAM CHICAGO TULSA BOSTON SALT LAKE CITY
PHILADELPHIA NEW YORK DETROIT SEATTLE CLEVELAND
SAN FRANCISCO HOUSTON ATLANTA HAVANA LOS ANGELES

(*Continued from page 58*)

appointed November 1946 by Minister of Health. Metropolitan Water Board contended setting up of Joint Advisory Water Committeee not best means of dealing with problem; most other water suppliers argued that Water Act provided effective means of pooling resources and amalgamation of water utilities where necessary. Problem of committee to decide relative merits of these points of view. 620 mgd.(Imp.) accepted subject to certain reservations as reasonable estimate of potential resources of Greater London area. (After completion of Wraysbury and Datchet Res. (10 yr. min.) will be under 660 mgd.) Estd. total requirements in 1960 will be 670 mgd.(Imp.). Study of water resources and demands therefore urgently required and simultaneously plans should be prepared for new major source of supply. Committee's opinion that resources of area must be treated as whole; believes that resources in area must be fully and rationally exploited before bringing in outside supply. Study of latter, however, should proceed simultaneously; considers that Sec. 14 of Water Act of '45 applying to extraction of underground water should be extended to whole area. Committee unable to agree on constitution and powers of authority to carry out above conclusions. Chairman and 1 member favor single all-purpose authority and 3 other members favor setting up 4 joint water boards with central authority to coordinate use of internal resources and develop major outside source. Reasons for single authority: [1] to spread capital cost of new works; [2] to provide for equation of water charges throughout area; [3] to coordinate internal resources of area; [4] to develop major outside source; [5] to simplify financial and administrative structure and make full use of best ability available. New single authority would be about $\frac{1}{16}$ area of TVA; capital outlays which would be taken over would approximate £80,000,000; employees would total 9,000 approximate. Single-authority membership suggested to consist of 5 full-time members: chairman, water engineer, geologist or chemist, accountant and person qualified by reason of administrative experience. These would be appointed by minister. 2 part-time members would also be appointed by him after consultation with local authorities. Other 3 members of committee agree that while central water authority should ultimately control all sources of supply in area it would be unwieldy and inefficient if it also concerned itself with distribution and administration. These members recommend setting up 4 joint boards, acting as independent supply authorities, which would purchase water in bulk from central authority and distribute it in their respective areas. Exploitation of water resources in joint-board areas would be at direction of central authority. Under joint-board plan, following composition of central authority suggested: chairman and deputy chairman appointed by minister and 17 representatives appointed by joint boards from their members (6 from Metropolitan Water Board, 3 each from each of other 3 joint boards, and 1 each from Thames Conservancy and Lee Conservancy Catchment Boards). Members would exercise managerial functions and have under them appropriate professional staff. Between 30 and 40 members suggested for Metropolitan Water Board and 15 to 20 for each of other 3 joint boards. Joint boards should be local in character, and local authorities, including county councils, should be represented. Financial structure of joint boards should be on lines similar to existing Metropolitan Water Board. Charges should be gradually equated within each joint-board area. Power of joint boards to raise capital or borrow money should

(*Continued on page 62*)

Yours for a Long Life of Trouble-Free Feeding



YOU CAN ALWAYS COUNT ON DEPENDABLE SERVICE FROM OMEGA UNIVERSAL FEEDERS

The unique oscillating throat mechanism is simple and sturdy: it avoids complicated parts and troublesome maintenance. Feeding mechanism and hopper agitation are driven simultaneously and with a minimum of working parts. Simple micrometer screw adjusts feeding rate over a 40 to 1 range. Feeds lime, soda ash, alum, ferric sulphate, etc., by volume with an accuracy of ± 3% or better — and handles lumps or fine powder with equal dependability.

Three sizes of Universal Feeders cover feeding ranges from 1 to 5,000 lbs. per hr. Dissolving chambers (as shown), dust collectors, extension hoppers, and proportional feeding controls are also available. Write today for descriptive bulletin — address Omega Machine Company (Division of Builders Iron Foundry), Providence 1, R. I.

OMEGA PRODUCTS

Volumetric Feeders • Gravimetric Feeders • Solution Feeders
Lime Slaking Equipment • Bucket Elevators • Laboratory Stirrers

THE LAST WORD IN FEEDERS

OMEGA

(Continued from page 60)

be subject to control of minister. Central water authority should sell bulk water at charges fixed by statute and precept for deficiency on joint boards in proportion to their rateable value. Joint boards in turn should not attempt to cover whole of this precept by their water charges but should precept in turn when necessary on local authorities in their area. This will provide for part of cost of providing water to be paid by general taxpayer and not whole cost left to consumer, on theory that adequate water supply benefits area as whole. 3 members feel that public water supply is necessity to all members of community, that it is public health service and should be controlled by elected representatives of local authorities in their respective areas.—*Harry B. Shaw.*

AMONG WATER WORKS MEN...
The
ELLIS PIPE CUTTER
is BEST
FOR CUTTING LARGE SIZES OF PIPE
No. 01 Cuts Pipe 4" to 8"
No. 1 Cuts Pipe 4" to 12"
IMMEDIATE DELIVERY NOW ON ELLIS PIPE CUTTERS
Write for circular and price list
ELLIS & FORD MFG. CO.
FERNDALE 20, MICH.

The King George VI Reservoir, Staines. Increased Storage for Metropolitan Water Board. ANON. Civ. Eng. (Br.), **43**:195 (Apr. '48). New reservoir was opened Nov. '47. Original Staines works, completed in '02, consist of 2 reservoirs with combined capac. of 3,338 mil.gal.(Imp.). Water flows in aqueduct from intake 1.75 mi. to pumping station immediately east of Staines. Here water forced by 5 pumping units through two 76″-diam. steel mains under max. head of 76′ for distance of 1200 yd. to two reservoirs. New reservoir, situated immediately west of 2 original reservoirs, 6111′ long, with variable width from 2166′ to 2886′. Water surface covers 350 acres. Continuous embankment encloses whole area. Trench sunk on centerline of embankment through ballast into underlying clay. Trench refilled with clay puddle continued above ground supported by embankment. Excavated material spread in thin layers and thoroughly consolidated. Inner face of bank with slope of 3:1, protected by concrete slabs. On its outer face bank has slope of 2.5:1, covered with soil sown with grass seed. Water will be pumped into reservoir through circular conduit, 6′6″ in diam., of welded steel shells surrounded by reinforced concrete and internally lined with cement.—*H. E. Babbitt.*

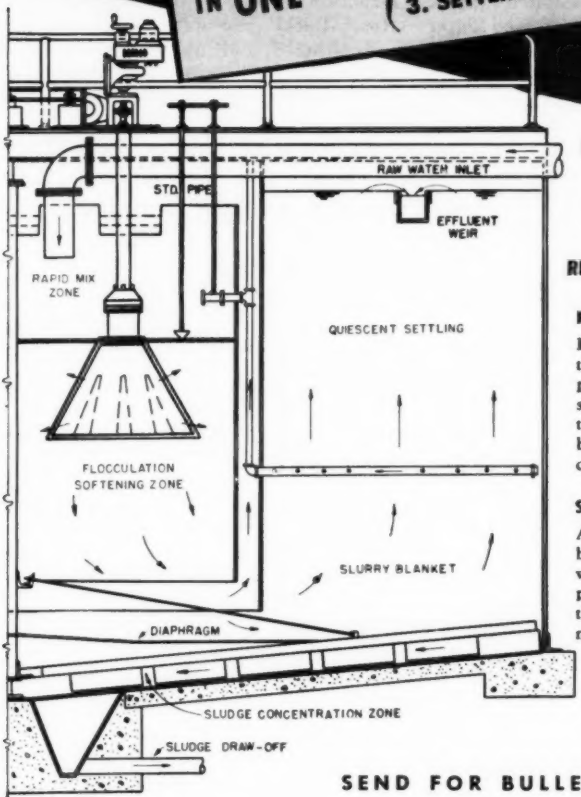
Sheffield Water Works Celebrates Its Diamond Jubilee May 22–29. ANON. Wtr. & Wtr. Eng. (Gt. Br.) **51**:311 (July '48). Thirteen impounding reservoirs, with total capacity of 6,813 mil.gal.(Imp.), or 168 days' storage, provide water for city. Over 936 mi. of pipes laid in city and district. Watershed covers 30,403 acres. Barker's Pool, constructed about 1631 as first artificial reservoir for water supplies, closed in 1793. In 1785 Old Great Dam at Crookesmoor completed and wooden pipeline laid to small working reservoir at Portobello

(Continued on page 64)

American FLOCSETTLER

PROVIDES COMPLETE, EFFICIENT WATER CONDITIONING

COMBINES IN ONE UNIT
1. RAPID MIX
2. FLOCCULATION
3. SETTLING



LIME SODA SOFTENING

TURBIDITY and COLOR REMOVAL

INDUSTRIAL WASTE RECOVERY and TREATMENT

RECIRCULATION CONTROL

Exact control of recirculation of lime sludge and partially treated water insures several passages of the water through slurry blanket before it is discharged as effluent.

SLURRY BLANKET CONTROL

Adjustable depth of slurry blanket—with automatic wasting of excess slurry—provides optimum condition for complete treatment and stabilization.

Design permits immediate normal operation after shut-downs.

SEND FOR BULLETIN NO. 256A

Our staff of Sanitary Engineers will cooperate with consulting and operating engineers in suggesting the process of treatment and type of equipment best suited to individual needs.

AMERICAN WELL WORKS

IN OUR 81ST YEAR
112 North Broadway
AURORA, ILLINOIS

Pumping, Sewage Treatment, and Water Purification Equipment
RESEARCH · ENGINEERING · MANUFACTURING

Offices: Chicago • New York • Cleveland • Cincinnati • Kansas City • Sales Representatives throughout the World

(*Continued from page 62*)

and on to cistern in Division St. In 1830 water company incorporated. Dale Dike Res., completed in 1864, had capac. of 710 mil.gal., covered 78 acres and was 95′ deep. At midnight on Friday, March 11, 1864, disaster occurred. In little more than ½ hour nearly ¼ of embankment washed away. 244 lives lost. 3 yr. later company obtained power to reconstruct this reservoir on more stable ground. Prior to 1830 water distributed through wooden pipes. In 1887 Sheffield Corp. acquired water works. Following acquisition, corporation endeavored to remedy defect in Damflask Res., from which water escaped through virgin strata around southern end of embankment. By Act of 1896, Sheffield obtained power to construct Langsett and Underbank Res., filter beds, etc. In 1867 water works obtained powers to construct Broomhead and More Hall Res., in Ewden Valley, with service reservoir at Wadsley and other ancillary works. In 1899 Derwent Valley Water Board created. Each of four corporations entitled to water obtained by board, Sheffield's 25% being 8.916 mgd. (Imp.). River Don Pumping Scheme completed in '21. After filtration, water pumped through 26″ main about 9 mi. to balancing tank near foot of Damflask Res. Policy of water committee to encourage public interest in activities of water undertaking. Parties shown over filtration works and water works laboratory. Lectures, with sound films, given on request. Literature available both to residents and visitors. During war years all efforts directed toward maintaining supply and little could be done to meet normal development. Workmen's canteen in operation since '42. In '39 corporation obtained "zone of protection" powers to reduce risk of pollution on watershed. No development of any kind can be undertaken on watershed without corporation approval. In '39 corporation empowered to expand supply system at estimated cost of £800,000. Work delayed by war. In '46 work started on Rivelin Filter Sta. to provide for additional supply on completion of Ladybower Res. Work finished early in '48. Output from station increased from 7.5 to 12 mgd. (Imp.). At Rivelin Upper Res. new overflow weir, new outlet control works and raising of puddle core wall completed in '47. Reinforced-concrete service reservoir now under construction on site of original Hadfield Res. Local resources now almost fully utilized, and substantial new supplies may have to be conveyed over longer distances.—*H. E. Babbitt.*

OTHER ARTICLES NOTED

Recent articles of interest, appearing in American periodicals not abstracted, are listed below.

The Possible Significance of Milk and Water in the Spread of Virus Infections. GORDON C. BROWN. Am. J. Pub. Health, **39**:6:764 (June '49).

Maintenance of Heat Transfer by Cooling Water Treatment. W. A. HALL & ROY F. WESTON. Ind. Eng. Chem. **41**:7:1409 (July '49).

Removal of Phenol and Cresols From Natural Waters. M. B. ETTINGER & C. C. RUCHHOFT. Ind. Eng. Chem., **41**:7:1422 (July '49).

Practical Geophysical Techniques for the Water Well Driller. CARL A. BAYS. Water Well Jour., **3**:3:8 (May–June '49).

Operation and Characteristics of Jet Pumps. C. B. SATTLER. Water Well Jour., **3**:3:19 (May–June '49).

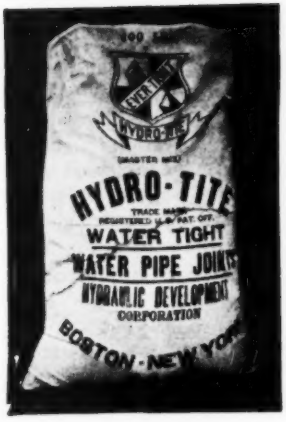
Photo-Interpretation of Transported Soil Materials. J. D. Mollard. Eng. Jour. (Can.), **32**:6:332 (June '49).

Forecasting Reservoir Shoreline Erosion. G. L. FUGATE. Wtr. & Sew. Wks., **96**:7:258 (July '49).

HYDRO-TITE

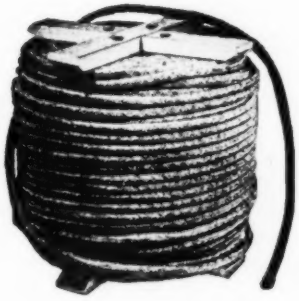
FOR IMMEDIATE DELIVERY AND PERMANENT JOINTS

Hydro-tite, the self-sealing, self-caulking, jointing compound can be supplied promptly in any quantity at any time from our warehouse stocks strategically located throughout the United States and Canada. Over thirty years of use has proved that pipe joints made with Hydro-tite, stay tight. Send for data book and sample.



ALWAYS USE FIBREX

The sanitary, bacteria-repellent paper packing that is used like braided jute. Seventy pounds of Fibrex takes the place of one hundred pounds of braided jute, with proportionate savings in cost. Send for sample.



HYDRAULIC DEVELOPMENT CORPORATION

Main Sales Office: 50 Church St., New York, N. Y.

Works: West Medford Station, Boston, Mass.

Service Lines

Articles on radioactive tracers for industrial applications are the subject of an extensive bibliography compiled by and available without charge from Arthur D. Little, Inc., Cambridge 42, Mass. Applications of potential interest to the water industry include radioactive well logging, measurement, and observation of flow in enclosed systems. Articles on all of these subjects are listed in the bibliography, although the applications may be in other than strictly water supply fields.

Graphite and carbon anodes and backfill material for cathodic protection applications are discussed in a descriptive folder issued by National Carbon Co., Inc., Room 1328, 30 E. 42nd St., New York 17. The bulletin, entitled Catalog Section M–8500A, describes their installation and operation. The graphite backfill material is used to lower anode-to-soil resistance, thereby prolonging the life of the anode itself.

Case histories of engineering projects planned by Parker & Hill, Cons. Engrs., Smith Tower, Seattle 4, Wash., are described and illustrated in a 20-page booklet, "It Can Be Done!", published by the firm.

"Engineering Facts About Transite Pressure Pipe" is a 12-page booklet just issued by Johns-Manville, 22 E. 40th St., New York 16. In addition to reprinting a series of current advertisements, the booklet contains tabular data on the weights and dimensions of the pipe.

"Dorr Equipment and Methods for Modern Water Pretreatment" is the subject of a new eight-page leaflet available from the Dorr Co., 570 Lexington Ave., New York 22, N.Y.

A guide, index and application chart for Inertol protective coatings are all contained in a 4-page, cross-indexed folder. Entitled "Public Works Folder No. 752," it is available from the company at 480–90 Frelinghuysen Ave., Newark 5, N.J.

New bulletins of the Worthington Pump & Machinery Corp., Harrison, N.J., include Vertical Turbine Pumps, Water (Bul. H–450–B34) and Oil (Bul. H–450–B35) Lubricated, and Self-Priming Centrifugal Pumps (Bul. W–395–B1). The folders describe the construction and performance of the pumps, and include capacity tables for the various sizes.

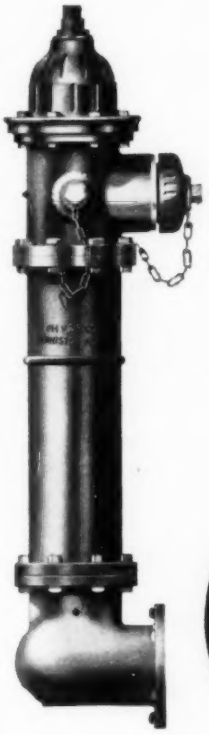
Turbine pumps for a variety of applications are described in two brochures issued by the Johnston Pump Co., 2324 E. 49th St., Los Angeles 11, Calif. Attractively designed and well illustrated, they explain the functioning of the various models and their applications. Oil lubricated pumps are described in Bul. 1013; water lubricated pumps in Bul. 1014.

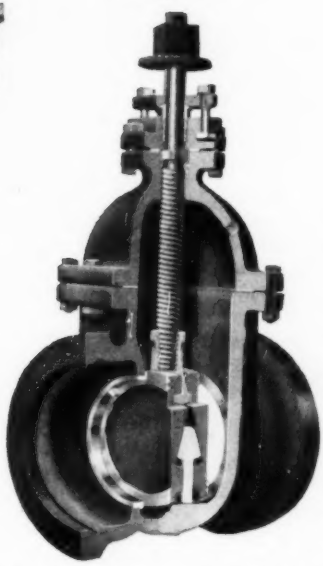
A second annual report on important steel water lines laid during the past year has been issued by Dresser Mfg. Div., Bradford, Pa. Entitled "A Report of Dresser-Coupled Steel Water Lines in the Year 1948," the booklet includes illustration, pertinent data, and descriptions of the lines.

Phase contrast accessories for microscopy are described and the principle explained in a new catalog issued by the Bausch & Lomb Optical Co., Rochester 2, N.Y., and available on request.

Chlorine feeding by the Builders volumetric Model DVS Chlorinizer is described in Bul. 840–F2, available on request from Builders-Providence, Inc., Providence 1, R.I. Cutaway and flow diagrams illustrate the operating principles and the special safety shutoff features.

(*Continued on page 68*)





Valves Hydrants

Hub Ends, Mechanical Joint, Flanged or Screwed.

●

M & H Products Include—

FIRE HYDRANTS
GATE VALVES
TAPPING VALVES
WALL CASTINGS
SPECIAL CASTINGS
TAPPING SLEEVES
CHECK VALVES
FLOOR STANDS
EXTENSION STEMS
SHEAR GATES
MUD VALVES
VALVE BOXES
FLAP VALVES
SLUDGE SHOES
FLANGE AND FLARE FITTINGS
FLANGED FITTINGS
B & S FITTINGS
CUTTING-IN TEES

VALVES: A.W.W.A. type, iron body, bronze mounted with double disc parallel seat or solid wedge type. Non-rising stem, outside screw and yoke, or with sliding stem and lever. Also furnished hydraulically operated. Square bottom type operates in any position. All rugged and dependable, made of best material with highest quality workmanship.

HYDRANTS: Standard A.W.W.A. type approved by Underwriters and Factory Mutuals. Dry top, revolving head, easy to lubricate. High efficiency because barrel diameter not reduced and there are no working parts or obstructions in waterway.

Write for Catalog No. 34

M&H VALVE AND FITTINGS COMPANY

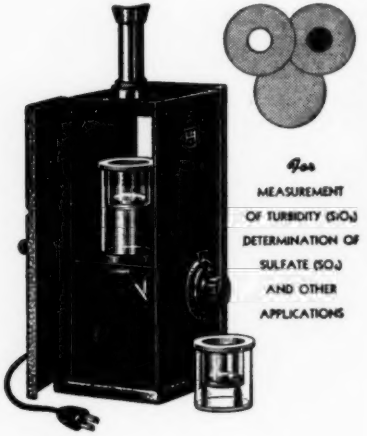
ANNISTON, ALABAMA

HELLIGE

TURBIDIMETER

A TURBIDIMETER WITHOUT STANDARDS

Accurate • Foolproof • Universal



The Hellige Turbidimeter does not require standard suspensions and is not affected by fluctuations in line voltage.

ACCURATE, FOOLPROOF AND UNIVERSAL, this precise instrument is ideally suited not only for turbidity and sulfate determinations of water but for measurements of suspended matter in general. Turbidity measurements can be made down to zero-turbid water.

Those familiar with the cumbersome, long tubes and inconvenient methods employed with older apparatus will appreciate the short tubes of the Hellige Turbidimeter and its simple operation which permits anyone without special training to make determinations quickly and accurately.

WRITE FOR CATALOG No. 8000

HELLIGE

INCORPORATED

3718 NORTHERN BLVD. LONG ISLAND CITY 1, N.Y.

(*Continued from page 66*)

A trenching machine said to combine low cost with wide versatility is described in Bul. 121 of the Construction Products Corp., 410 San Fernando Rd., Los Angeles 31, Calif.

The trencher is an addition to the line of Profit System Companion Tools and can be adjusted to make cuts 12 to 18 in. wide and up to 52 in. deep.

Construction views of a prestressed concrete tank being built by the "Gunite" method are contained in a folder issued by the Pressure Concrete Co., 193 Emmet St., Newark 5, N.J.

"The ABC of Large Induction Motors" is a special 32-page issue of the *E–M Synchronizer* devoted to an exposition of the basic theory, operation, characteristics and applications of such motors. The booklet is distributed by Electric Machinery Mfg. Co., Minneapolis 13, Minn., and was written by G. L. Oscarson, chief application engineer of that company.

Filter Sand and Gravel

WELL WASHED AND CAREFULLY GRADED TO ANY SPECIFICATION.
PROMPT SHIPMENT IN BULK OR IN BAGS OF 100 LB. EACH.

Inquiries Solicited

Northern Gravel Co.

P. O. Box 307, Muscatine, Iowa

Whether you judge it on its resistance to corrosion, incrustation and leakage . . . on the uniformity of its enamel coating . . . or on its day-after-day economy, Bethlehem Tar-Enameled Water Pipe is the right pipe for water supply lines.

Bethlehem Tar-Enameled Water Pipe meets every performance requirement because it is accurately formed and welded from a heavy grade of plate steel, then well coated over every square inch of surface with a smooth, uniform layer of protective tar enamel.

It is regularly supplied in all diameters up to 96 in., and for special needs can be furnished in larger diameters up to the maximum permitted by shipping clearances. It comes in a wide range of thicknesses, too, and in lengths up to 40 ft.

Just say the word, and we'll have our representative call with details.

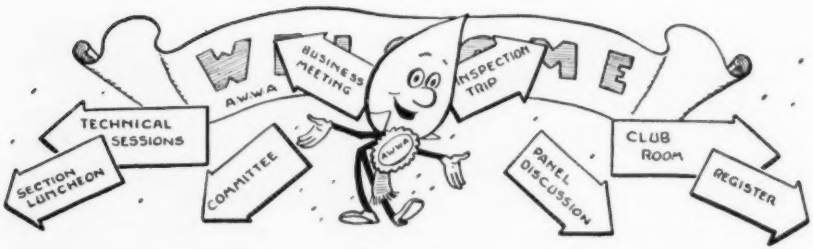
BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

Fabricated Steel Construction

On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation
Export Distributor:
Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM *Tar-Enameled* WATER PIPE



Section Meeting Reports

Canadian Section: The 29th Convention of the Canadian Section was held in the city of Quebec on April 25–27, 1949. This was the first time that the annual meeting was held in this city. In spite of the fact that it is off center from the membership population, the registration reached a figure of 574, and the convention was in every way a successful one.

This year's program consisted of five written papers and a series of guided discussions. The latter consisted of a number of questions, with the discussion being opened by selected persons and continued by anyone who wished to participate.

J. A. Tremblay, water works engineer for the city of Quebec, outlined the developments that have taken place in that city since the first water works system was constructed in 1853. The water is obtained from Lake St. Charles and supplemented by other lakes. It is a gravity supply, but at present consideration is being given to alternative supplies which will meet the increased demand for water.

Miss Norma Nelson of the Public Service Commission of Halifax gave an interesting paper on the subject "The Use for Public Relations in Canadian Water Works Practice." In this, she outlined what good public relations consist of, and indicated how a water works department can accomplish much by following common sense procedures in this field.

F. W. Gilcreas, assistant director in charge of the Div. of Laboratories and Research, New York State Dept. of Health at Albany, was the speaker on the subject "The Value of Laboratory Examinations in the Control of Water Treatment." In this, he gave a comprehensive review of the part the laboratory plays in providing a water supply that is free from bacterial contamination but is also satisfactory for the many other purposes for which it is used in a municipality.

"Free Residual Chlorination at Brantford" was the subject of a paper by D. B. Williams, in charge of Water Purification at Brantford, Ont. This water is obtained from the Grand River, and is subject to serious taste problems. The paper presented a review of the different methods that have been tried, and the present use of free residual chlorination to accom-

(*Continued on page 72*)

CONCRETE PIPE

. . . the Economy "Champ" for Waterlines

Yes, concrete pipe for waterlines is the champion—any way you look at it. Its first cost is moderate, it lasts a lifetime and its annual cost for upkeep is mighty low. Taken together all these add up to ***low-annual-cost*** waterlines.

Concrete pipe has the structural strength to resist the strain of continuous heavy-duty service. It sustains heavy overburdens; its tight joints and uniformly dense structure prevent leakage. There is no tuberculation and far less incrustation in concrete pipe waterlines to impair their hydraulic capacity; taste, odor and dirty water conditions are minimized.

In the construction of the concrete water main in Kansas City, Mo., shown above, more than 7 miles of large diameter concrete water pipe was used. Samuel Kraus, of St. Louis, was the contractor.

Whether you are planning a large water line like this Kansas City project or a small, local community or industrial job—specify concrete pipe for long life and dependable ***low-annual-cost*** service.

PORTLAND CEMENT ASSOCIATION

33 West Grand Avenue, Chicago 10, Illinois

A national organization to improve and extend the uses of portland cement and concrete . . . through scientific research and engineering field work

(*Continued from page 70*)

plish the objective of providing a water with a minimum of taste. The discussion on this was opened by A. E. Griffin of the Wallace and Tiernan Co., Newark, N.J., and J. F. MacLaren, consulting engineer of Toronto.

The final paper on the program was given by H. R. Hooper, engineer of distribution of the Water Works Dept. at Ottawa, Ont., on the subject "Water Consumption in Canadian Municipalities." It has been noted that water consumption in most municipalities has been increasing for some time. Mr. Hooper's paper gives a review of information secured through questionnaires from various water works departments in Canada. He referred to a number of factors responsible for this general upward trend in water consumption to-day.

In the guided discussions, the following subjects were dealt with: "Financing of Water Works Systems" under the chairmanship of W. Storrie, Toronto; "Standardization of Corporation Cocks and Service Lines" with R. H. Martindale of Sudbury as chairman; "Meeting Peak Demands in Water Supply" with W. D. Hurst of Winnipeg as chairman; and "Salaries and Working Conditions for Water Works Personnel" of which J. W. Peart of St. Thomas was the chairman. All of these discussions referred to problems with which the water works man is confronted frequently. They evoked considerable discussion from those in attendance.

The social functions of the convention consisted of a luncheon on the opening day, and a banquet on the second evening. The Canadian Water Works Equipment Assn. sponsors the Club Room, and again it was the focal point for social activity. Here it was possible to meet most everyone at the convention, and to become better acquainted. The equipment association also provided a fine entertainment following the banquet.

Following the banquet, a number of awards and presentations were made. The Past Chairman's Certificate was presented to F. J. Veale. The present Chairman, R. H. Martindale, received an engraved cane in recognition of his work as Chairman. The Fuller Award nominee was announced to be J. C. Keith of Windsor. The Hunt Memorial Award for

(*Continued on page 74*)

BOND-O

A safe and dependable self-caulking, self-sealing compound for jointing water mains. Used with complete confidence by hundreds of water works.

BOND-O is machine-blended for absolute uniformity and contains a germicide to inhibit oxidation by sulfur bacteria. BOND-O Rubber Packing Gaskets are resilient—bacteria-free and quickest of all packings to install. Made in sizes 4" to 60".

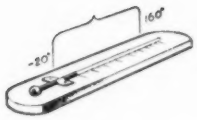
Northrop

NORTHROP & COMPANY, INC.
SPRING VALLEY, N. Y.

• Every Bond-o Joint is a Good Joint •

5 OUTSTANDING ADVANTAGES

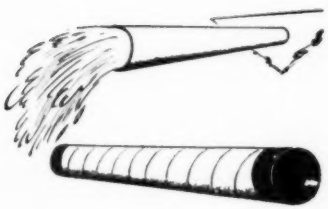
of Barrett* protective coatings for the Water Industries



1. **They are unaffected by Wide Temperature Changes** Barrett* Waterworks Enamels neither flow nor sag in temperatures as high as 160°F. Nor do they crack in temperatures as low as 20° below zero.

2. **They are Flexible and Ductile** They possess sufficient elasticity to withstand "breathing" of the pipe as pressures fluctuate, and out-of-round deflection when the pipe is being installed or by the weight of the backfill when the pipe is out of service.

3. **They prevent Tuberculation** When used to line the inside of a pipe, Barrett Waterworks Enamels prevent tuberculation, thus enabling the pipe to maintain its original capacity.



4. **They increase the Coefficient of Flow** After lining with Barrett Waterworks Enamels, Hazen-Williams "C" averages 150. Initial power installation is less expensive, and owing to the prevention of tuberculation, the cost of power does not increase after years of service.

5. **They assure Firm Bond** Barrett Waterworks Enamels assure a firmer bond at the interfaces of steel, primer, and enamel.

BARRETT WATERWORKS ENAMELS are manufactured specifically to meet the requirements of the water industries. Long and extensive service in the field has proved their worth. The Barrett organization will be glad to advise on materials and on application procedure, and to consult with you on any pipe-coating problem.

Barrett*

THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.
*Reg. U.S. Pat. Off.

(*Continued from page 72*)

efficient water works operation went to Charles W. Noice, St. Marys, Ont. Section Memorial Awards consisting of Certificates were presented to the families of the late W. H. Powell and W. H. Waddell. In addition to these presentations, Membership Service Awards were announced. They consist of suitably engrossed certificates given to those members who have served either 15, 20, 25 or 30 years continuously in the Section. Charles H. Taylor, Chairman of the Canadian Water Works Equipment Assn., was the recipient of a silver tray from the Canadian Section, and a watch and other gifts from the equipment association on the occasion of his retirement from the Neptune Meter Co. Mrs. W. J. Orchard received a gift of Canadian handicraft in recognition of her visit to the Canadian Section meeting. The local Ladies Committee and others received gifts from the Section.

The convention closed with a membership of 490 in the Section. This is a gain of 31 over the previous year, and again establishes a new peak for the Section.

Ladies registered to the number of 147. An excellent programme had been prepared for them by the local committee, consisting of afternoon tea and luncheon, along with an inspection trip in company with the men on the afternoon of the second day.

A. E. BERRY
Secretary-Treasurer

Hundreds upon hundreds of valves on land and sea — for every conceivable use, are being safely, speedily and dependably opened and closed by "*Limi-Torques*", day in and day out.

. . . of great interest to Water Works & Sewerage Engineers and Operators . . . .

This catalog shows different types; how they work; how they are connected; wiring diagrams; control panels; floor stands; position indicators; pictures of "*LimiTorques*" in action; views of "*Limi-Torques*" applied to many makes of valves, etc.—indeed, a veritable "treatise" on Motorized Valve Operation.

Please use your *business letterhead* when writing for this valuable catalog.

PHILADELPHIA GEAR WORKS, Inc.
ERIE AVENUE and "G" STREET, PHILADELPHIA 34, PA.
New York · Pittsburgh · Chicago
In Canada: William and J. G. Greey Limited, Toronto

SERVICE LINES OF COPPER
Save you Time and Money
COPPER TUBE service lines installed over the years in all sections of the country have proved their dependability. They have justified the use of non-rust copper for underground service and have established their economy through maintenance savings.
Today, more than ever before, copper water tubes are used for water distribution within homes and buildings. Surely the line from main to meter should have equal durability.
Type K Anaconda Copper Water Tubes are furnished soft in 60-foot coils by wholesale distributors throughout the country.
4908
ANACONDA
from mine to consumer
Anaconda
COPPER TUBES
THE AMERICAN BRASS COMPANY
General Offices: Waterbury 88, Connecticut
Subsidiary of Anaconda Copper Mining Company
In Canada: ANACONDA AMERICAN BRASS LTD.
New Toronto, Ont.

(Continued from page viii)

19–21—Alabama-Mississippi Section in Jackson, Miss. Secretary: John L. Snow, Dist. Engr., Layne-Central Co., 601 First National Bank Bldg., Montgomery 4, Ala.

24–25—Virginia Section at Roanoke Hotel, Roanoke, Va. Secretary: W. H. Shewbridge, Asst. Engr., State Health Dept., 713 State Office Bldg., Richmond 19, Va.

26–28—California Section in Sacramento, Calif. Secretary: H. C. Medbery, Chief Water Purif. Engr., Water Dept., 425 Mason St., San Francisco 2, Calif.

31-Nov. 2—Kentucky-Tennessee Section at Lafayette and Phoenix Hotels, Lexington, Ky. Secretary: R. P. Farrell, Director, Div. of San. Eng., State Dept. of Public Health, 420—6th Ave., N., Nashville 3, Tenn.

November 2–4—Chesapeake Section at Wardman Park Hotel, Washington, D.C. Secretary: Carl J. Lauter, 5902 Dalecarlia Pl., N.W., Washington 16, D.C.

3–4—Ohio Section in Dayton, Ohio. Secretary: F. P. Fischer, Sales Engr., Wallace & Tiernan Co., Inc., 812 Perry Payne Bldg., Cleveland 13, Ohio.

7–9—North Carolina Section at Highland Pines Inn, Southern Pines, N.C. Secretary: E. C. Hubbard, Prin. San. Engr., State Board of Health, Raleigh, N.C.

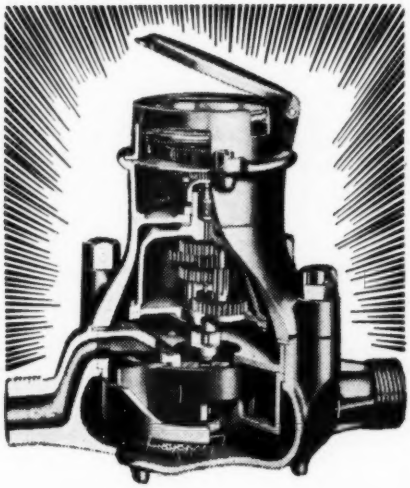
11–13—Arizona Section at San Carlos Hotel, Yuma, Ariz. Secretary: Mrs. Helen Rotthaus, San Eng. Div., State Dept. of Health, Phoenix, Ariz.

14–16—Florida Section at Orange Court Hotel, Orlando, Fla. Secretary: A. E. Williamson Jr., P.O. Box 1431, Daytona Beach, Fla.

17–19—New Jersey Section at Madison Hotel, Atlantic City, N.J. Secretary: C. B. Tygert, Wallace & Tiernan Co., Inc., Box 178, Newark 1, N.J.

December 5–7—Southeastern Section at Gordon Hotel, Albany, Ga. Secretary: T. A. Kolb, San. Engr., State Board of Health, Wade Hampton Bldg., Columbia, S.C.

STANDARDIZE TODAY



On Tomorrow's Meter . . .

CALMET

Continuing increases in per capita water consumption change and multiply metering needs in many ways. CALMET'S larger capacity, oscillating piston principle and interchangeability of parts can help you meet these changing requirements effectively. Standardize TODAY on CALMETS . . . the water meters of TOMORROW . . . for profitable metering.

● *SALES REPRESENTATIVES— Write for complete details of the CALMET franchise in your territory.*

CALMET WATER METERS

MADE BY WELL MACHINERY & SUPPLY CO., INC.—FORT WORTH, TEXAS

Index of Advertisers' Products

Acidizing of Water Wells:
Dowell Incorporated

Activated Carbon:
Industrial Chemical Sales Div.

Aerators (Air Diffusers):
Infilco, Inc.
Permutit Co.
Walker Process Equipment, Inc.

Air Compressors:
DeLaval Steam Turbine Co.
Worthington Pump & Mach. Corp.

Air-Lift Pumping Systems:
Worthington Pump & Mach. Corp.

Alum (Sulfate of Alumina):
American Cyanamid Co., Industrial Chemicals Div.
General Chemical Div.

Ammonia, Anhydrous:
General Chemical Div.

Ammonia Receivers:
Worthington Pump & Mach. Corp.

Ammoniators:
Everson Mfg. Corp.
Proportioneers, Inc.
Wallace & Tiernan Co., Inc.

Brass Goods:
American Brass Co.
M. Greenberg's Sons
Hays Mfg. Co.
James Jones Co.
Mueller Co.
A. P. Smith Mfg. Co.

Carbon Dioxide Generators:
Infilco, Inc.
Walker Process Equipment, Inc.

Cathodic Protection:
Dowell Incorporated (magnesium anodes)
Electro Rust-Proofing Corp.

Cement Mortar Lining:
Centriline Corp.

Chemical Cleaning of Water Mains:
Dowell Incorporated

Chemical Feed Apparatus:
Belco Industrial Equipment Div., Inc.
Builders-Providence, Inc.
Everson Mfg. Corp.
Infilco, Inc.
Omega Machine Co. (Div., Builders Iron Fdry.)
Permutit Co.
Proportioneers, Inc.
Ross Valve Mfg. Co.
Simplex Valve & Meter Co.
Wallace & Tiernan Co., Inc.

Chemical Scale Removal Services:
Dowell Incorporated

Chemists and Engineers:
(See Prof. Services, pp. 24-27)

Chlorination Equipment:
Everson Mfg. Corp.
Proportioneers, Inc.
Wallace & Tiernan Co., Inc.

Chlorine Comparators:
Everson Mfg. Corp.
Hellige, Inc.
Klett Mfg. Co.
LaMotte Chemical Products Co.
Proportioneers, Inc.
Wallace & Tiernan Co., Inc.

Chlorine, Liquid:
Solvay Sales Div.
Wallace & Tiernan Co., Inc.

Clamps and Sleeves, Pipe:
James B. Clow & Sons
Dresser Mfg. Div.
M. Greenberg's Sons
James Jones Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
Warren Foundry & Pipe Corp.

Clamps, Bell Joint:
James B. Clow & Sons
Dresser Mfg. Div.

Clamps, Pipe Repair:
James B. Clow & Sons
Dresser Mfg. Div.
Warren Foundry & Pipe Corp.

Clarifiers:
Chain Belt Co.
Dorr Co.
Infilco, Inc.
Permutit Co.
Walker Process Equipment, Inc.

Cleaning Water Mains:
Flexible Underground Pipe Cleaning Co.
National Water Main Cleaning Co.

Cocks, Curb and Corporation:
Hays Mfg. Co.
James Jones Co.
A. P. Smith Mfg. Co.

Compressors, Portable:
Worthington Pump & Mach. Corp.

Condensers:
United States Pipe & Foundry Co.

Contractors, Water Supply:
Layne & Bowler, Inc.

Controllers, Liquid Level, Rate of Flow:
Builders-Providence, Inc.
Infilco, Inc.
Simplex Valve & Meter Co.
R. W. Sparling

Copper Sheets:
American Brass Co.

Copper Sulfate:
General Chemical Div.

Corrosion Control:
Calgon, Inc.

Couplings, Flexible:
DeLaval Steam Turbine Co.
Dresser Mfg. Div.
Fairbanks, Morse & Co.
Philadelphia Gear Works, Inc.

Culture Media:
Difco Laboratories, Inc.

Dechlorinating Agent:
Virginia Smelting Co.

Diaphragms, Pump:
Dorr Co.
Proportioneers, Inc.

Engines, Hydraulic:
Ross Valve Mfg. Co.

Engineers and Chemists:
(See Prof. Services, pp. 24-27)

Feed Water Treatment:
Calgon, Inc.
Infilco, Inc.

Filter Materials:
Anthracite Equipment Corp.
Infilco, Inc.
Northern Gravel Co.

Filters, Incl. Feed Water:
Belco Industrial Equipment Div., Inc.
Dorr Co.
Everson Mfg. Corp.
Infilco, Inc.
Permutit Co.
Roberts Filter Mfg. Co.
Ross Valve Mfg. Co.
Walker Process Equipment, Inc.

Filtration Plant Equipment:
Builders-Providence, Inc.
Chain Belt Co.
Difco Laboratories, Inc.
Infilco, Inc.
Omega Machine Co. (Div., Builders Iron Fdry.)
Roberts Filter Mfg. Co.
Walker Process Equipment, Inc.
Welsbach Corp., Ozone Processes Div.

Finders, Pipe:
Jos. G. Pollard Co., Inc.

Fish Screens:
Electric Fish Screen Co.

Fittings, Copper Pipe:
Dresser Mfg. Div.
M. Greenberg's Sons
Hays Mfg. Co.
James Jones Co.

Fittings, Tees, Ells, etc.:
Cast Iron Pipe Research Assn.
James B. Clow & Sons
Dresser Mfg. Div.
James Jones Co.
Kennedy Valve Mfg. Co.
M & H Valve & Fittings Co.
United States Pipe & Foundry Co.
Warren Foundry & Pipe Corp.
R. D. Wood Co.

Flocculating Equipment:
Chain Belt Co.
Dorr Co.
Infilco, Inc.

Furnaces:
Jos. G. Pollard Co., Inc.
A. P. Smith Mfg. Co.

Furnaces, Joint Compound:
Northrop & Co., Inc.

Gages, Liquid Level:
Builders-Providence, Inc.
Infilco, Inc.
Simplex Valve & Meter Co.

Gages, Loss of Head, Rate of Flow, Sand Expansion:
Builders-Providence, Inc.
Infilco, Inc.
Northrop & Co., Inc.
Simplex Valve & Meter Co.
R. W. Sparling

Minimum *Through* Freight Rates with "In-Transit Privileges" at St. Louis

. . . standard pipeprotection, inc. . . . offers two outstanding advantages to purchasers of pipe

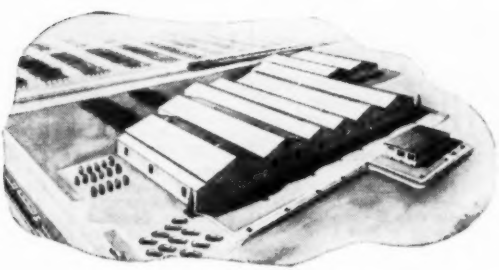
1 When you ship through the St. Louis gateway you use "through freight rates" instead of the higher combination rates generally used. This in-transit privilege permits stop-off for processing or storage up to 12 months at St. Louis without freight penalty.

2 Your pipe is cleaned, coated and wrapped to your own specifications by modern streamlined methods. Our plant and facilities (covering 22 acres) represent the last word in pipe handling equipment. The techniques used are the best practices that have been developed through experience by the industry.

From start to finish, the manufacturing process is controlled by standard procedures. This guarantees new standards of protection — new records in performance—important considerations these days to every buyer of pipe.

standard pipeprotection, inc.

3000 South Brentwood Boulevard St. Louis 17, Missouri



Our plant, handling the smaller diameters of pipe, is now in operation. For full information about schedules write today.

Gasholders:
Chicago Bridge & Iron Co.
Pittsburgh-Des Moines Steel Co.

Gaskets, Rubber Packing:
Northrop & Co., Inc.

Gates, Shear and Sluice:
Armco Drainage & Metal Products, Inc.
R. D. Wood Co.

Gears, Speed Reducing:
DeLaval Steam Turbine Co.
Philadelphia Gear Works, Inc.

Glass Standards—Colorimetric Analysis Equipment:
Hellige, Inc.
Klett Mfg. Co.
LaMotte Chemical Products Co.
Photovolt Corp.
Wallace & Tiernan Co., Inc.

Goosenecks (with or without Corporation Stops):
Hays Mfg. Co.
James Jones Co.
A. P. Smith Mfg. Co.

Greensand; *see* Zeolite

Hydrants:
James B. Clow & Sons
M. Greenberg's Sons
James Jones Co.
Kennedy Valve Mfg. Co.
John C. Kupferle Foundry Co.
Ludlow Valve Mfg. Co.
Mueller Co.
A. P. Smith Mfg. Co.
Rensselaer Valve Co.
Ross Valve Mfg. Co.
R. D. Wood Co.

Hydrogen Ion Equipment:
Hellige, Inc.
LaMotte Chemical Products Co.
Photovolt Corp.
Wallace & Tiernan Co., Inc.

Iron Removal Plants:
American Well Works
Belco Industrial Equipment Div., Inc.
Chain Belt Co.
Infilco, Inc.
Permutit Co.
Roberts Filter Mfg. Co.
Walker Process Equipment, Inc.
Welsbach Corp., Ozone Processes Div.

Jointing Materials:
Atlas Mineral Products Co.
Michael Hayman & Co., Inc.
Hydraulic Development Corp.
Leadite Co., Inc.
Northrop & Co., Inc.

Joints, Mechanical, Pipe:
Carson-Cadillac Co.
Cast Iron Pipe Research Assn.
Central Foundry Co.
James B. Clow & Sons
Dresser Mfg. Div.
United States Pipe & Foundry Co.
Warren Foundry & Pipe Corp.
R. D. Wood Co.

Lime Slakers and Feeders:
Dorr Co.
Infilco, Inc.
Omega Machine Co. (Div., Builders Iron Fdry.)

Magnesium Anodes (Corrosion Control):
Dowell Incorporated

Manometers, Rate of Flow:
Builders-Providence, Inc.

Meter Boxes:
Art Concrete Works
Ford Meter Box Co.
Pittsburgh Equitable Meter Div.

Meter Couplings and Yokes:
Badger Meter Mfg. Co.
Dresser Mfg. Div.
Ford Meter Box Co.
Hays Mfg. Co.
Hersey Mfg. Co.
James Jones Co.
Mueller Co.
Neptune Meter Co.
Pittsburgh Equitable Meter Div.
A. P. Smith Mfg. Co.
Worthington-Gamon Meter Co.

Meter Reading and Record Books:
Badger Meter Mfg. Co.
Buffalo Meter Co.

Meter Testers:
Badger Meter Mfg. Co.
Ford Meter Box Co.
Hersey Mfg. Co.
Neptune Meter Co.
Pittsburgh Equitable Meter Div.

Meters, Domestic:
Badger Meter Mfg. Co.
Buffalo Meter Co.
Hersey Mfg. Co.
Neptune Meter Co.
Pittsburgh Equitable Meter Div.
A. P. Smith Mfg. Co.
Well Machinery & Supply Co.
Worthington-Gamon Meter Co.

Meters, Filtration Plant, Pumping Station, Transmission Line:
Builders-Providence, Inc.
Infilco, Inc.
Simplex Valve & Meter Co.
R. W. Sparling

Meters, Industrial, Commercial:
Badger Meter Mfg. Co.
Buffalo Meter Co.
Builders-Providence, Inc.
Hersey Mfg. Co.
Neptune Meter Co.
Pittsburgh Equitable Meter Div.
Simplex Valve & Meter Co.
A. P. Smith Mfg. Co.
R. W. Sparling
Well Machinery & Supply Co.
Worthington-Gamon Meter Co.

Mixing Equipment:
Belco Industrial Equipment Div., Inc.
Chain Belt Co.
Infilco, Inc.

Ozonation Equipment:
Welsbach Corp., Ozone Processes Div.

Pipe, Asbestos-Cement:
Johns-Manville Corp.
Keasbey & Mattison Co.

Pipe, Brass:
American Brass Co.

Pipe, Cast Iron (and Fittings):
American Cast Iron Pipe Co.
Cast Iron Pipe Research Assn.
Central Foundry Co.
James B. Clow & Sons
United States Pipe & Foundry Co.
Warren Foundry & Pipe Corp.
R. D. Wood Co.

Pipe, Cement Lined:
Cast Iron Pipe Research Assn.
Central Foundry Co.
James B. Clow & Sons
Preload Companies, The
United States Pipe & Foundry Co.
Warren Foundry & Pipe Corp.
R. D. Wood Co.

Pipe Coatings and Linings:
The Barrett Div.
Cast Iron Pipe Research Assn.
Centriline Corp.
Koppers Co., Inc.
Preload Companies, The
Reilly Tar & Chemical Co.
Standard Pipeprotection, Inc.
Warren Foundry & Pipe Corp.

Pipe, Concrete:
American Pipe & Construction Co.
Lock Joint Pipe Co.

Pipe, Copper:
American Brass Co.

Pipe Cutting Machines:
Ellis & Ford Mfg. Co.
Jos. G. Pollard Co., Inc.
A. P. Smith Mfg. Co.

Pipe Jointing Materials:
(See Jointing Materials)

Pipe, Steel:
Armco Drainage & Metal Products, Inc.
Bethlehem Steel Co.

Plugs, Removable:
James B. Clow & Sons
Jos. G. Pollard Co., Inc.
A. P. Smith Mfg. Co.
Warren Foundry & Pipe Corp.

Potentiometers:
Hellige, Inc.

Pressure Regulators:
Ross Valve Mfg. Co.

Pumps, Boiler Feed:
DeLaval Steam Turbine Co.
Fairbanks, Morse & Co.
Peerless Pump Div., Food Machinery Corp.

Pumps, Centrifugal:
American Well Works
DeLaval Steam Turbine Co.
Economy Pumps, Inc.
Fairbanks, Morse & Co.
Peerless Pump Div., Food Machinery Corp.

Pumps, Chemical Feed:
Everson Mfg. Corp.
Infilco, Inc.
Proportioneers, Inc.
Wallace & Tiernan Co., Inc.

Pumps, Deep Well:
American Well Works
Fairbanks, Morse & Co.
Layne & Bowler, Inc.
Peerless Pump Div., Food Machinery Corp.
Worthington Pump & Mach. Corp.

Pumps, Diaphragm:
Dorr Co.
Proportioneers, Inc.

Pumps, Hydrant:
Jos. G. Pollard Co., Inc.

Pumps, Hydraulic Booster:
Fairbanks, Morse & Co.
Ross Valve Mfg. Co.

Pumps, Sewage:
DeLaval Steam Turbine Co.
Economy Pumps, Inc.
Fairbanks, Morse & Co.
Peerless Pump Div., Food Machinery Corp.

Pumps, Sump:
DeLaval Steam Turbine Co.
Economy Pumps, Inc.
Fairbanks, Morse & Co.
Peerless Pump Div., Food Machinery Corp.

PRECISION CONTROL

WITH

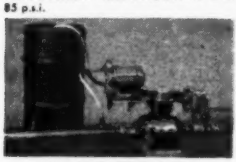
% PROPORTIONEERS %

Positive Displacement Proportioning Pumps

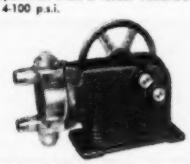
Diatomaceous Earth Filters

pH CONTROL
COAGULATION CONTROL
FILTRATION CONTROL
CORROSION CONTROL
ALGAE CONTROL
DECHLORINATION CONTROL
TASTE AND ODOR CONTROL
TOOTH DECAY CONTROL
ZEOLITE GENERATION CONTROL
BACTERIA CONTROL
RUST CONTROL
SEWAGE TREATMENT

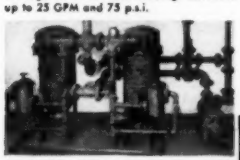
FOR PUMPED WATER SYSTEMS
Constant Rate Feeder — Heavy Duty Midget Chem-O-Feeder. Feeds 0-7½ GPH at 0 to 85 p.s.i.



FOR VARIABLE FLOW SYSTEMS
Flow Proportional Feeder — Automatic and Proportional Chem-O-Feeder. Feeds 0-5 GPH at 4-100 p.s.i.



FOR YOUR CAMP Du-Self — a complete Package Unit—for water treating. For flows up to 25 GPM and 75 p.s.i.



FOR YOUR SWIM POOL For crystal clear swim pool water — Pur-O-Cel Diatomaceous Earth Filter, Duplex Model.

NEW IMPROVED CHEM-O-FEEDER

MODEL 1-47

This new Heavy Duty Chem-O-Feeder has many added features for precision control and easier maintenance. Stroke length is instantly adjustable by turning a knob while pump is operating — a magnifying register glass shows exact reading in thousandths of an inch over a range from 2 to 13 cc per stroke. The new Model 1-47 has convenient oil fill and handy sight gauge — all moving parts operate in an oil bath. Plastic "See-thru" reagent head handles any chemical used in the water works field. Available in simplex, duplex and triplex models. Bulletin SAN-7.

With %Proportioneers% Equipment you can always maintain precision control in water purification and sewage treatment. Ask us for recommendations and quotations. Our experience from over 27,000 installations is at your service.

Write for Bulletins.

% PROPORTIONEERS, INC. %

Providence 1, R. I.

Pumps, Turbine:
DeLaval Steam Turbine Co.
Fairbanks, Morse & Co.
Layne & Bowler, Inc.
Peerless Pump Div., Food Machinery Corp.
Worthington Pump & Mach. Corp.

Recorders, Gas Density CO_2, NH_3, SO_2, etc.:
Permutit Co.
Wallace & Tiernan Co., Inc.

Recording Instruments:
Builders-Providence, Inc.
Infilco, Inc.
R. W. Sparling
Wallace & Tiernan Co., Inc.

Reservoirs, Steel:
Chicago Bridge & Iron Co.
Pittsburgh-Des Moines Steel Co.

Sand Expansion Gages:
(See Gages)

Sleeves:
(See Clamps)

Sleeves and Valves, Tapping:
James B. Clow & Sons
Mueller Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.

Sludge Blanket Equipment:
Permutit Co.

Soda Ash:
Solvay Sales Div.

Sodium Hexametaphosphate:
Calgon, Inc.

Softeners:
Belco Industrial Equipment Div., Inc.
Dorr Co.
Infilco, Inc.
Permutit Co.
Roberts Filter Mfg. Co.
Walker Process Equipment, Inc.

Softening Chemicals and Compounds:
Calgon, Inc.
Infilco, Inc.
Permutit Co.

Standpipes, Steel:
Chicago Bridge & Iron Co.
Pittsburgh-Des Moines Steel Co.

Steel Plate Construction:
Bethlehem Steel Co.
Chicago Bridge & Iron Co.
Pittsburgh-Des Moines Steel Co.

Storage Tanks:
Bethlehem Steel Co.
Chicago Bridge & Iron Co.
Pittsburgh-Des Moines Steel Co.

Strainers, Suction:
M. Greenberg's Sons
R. D. Wood Co.

Sulfur Dioxide, Liquid:
Virginia Smelting Co.

Surface Wash Equipment:
Permutit Co.

Swimming Pool Sterilization:
Belco Industrial Equipment Div., Inc.
Everson Mfg. Corp.
Omega Machine Co. (Div., Builders Iron Fdry.)
Proportioneers, Inc.
Wallace & Tiernan Co., Inc.
Welsbach Corp., Ozone Processes Div.

Tanks, Steel:
Bethlehem Steel Co.
Chicago Bridge & Iron Co.
Pittsburgh-Des Moines Steel Co.

Tapping Machines:
Hays Mfg. Co.
Mueller Co.
A. P. Smith Mfg. Co.

Taste and Odor Removal:
Industrial Chemical Sales Div.
Infilco, Inc.
Proportioneers, Inc.
Walker Process Equipment, Inc.
Wallace & Tiernan Co., Inc.
Welsbach Corp., Ozone Processes Div.

Telemeters, Level, Pump Control, Rate of Flow, Gate Position, etc.:
Builders-Providence, Inc.

Turbidimetric Apparatus (For Turbidity and Sulfate Determinations):
Hellige, Inc.
Wallace & Tiernan Co., Inc.

Turbines, Steam:
DeLaval Steam Turbine Co.

Turbines, Water:
DeLaval Steam Turbine Co.

Valve Boxes:
Central Foundry Co.
James B. Clow & Sons
Ford Meter Box Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Valve Inserting Machines:
A. P. Smith Mfg. Co.

Valves, Altitude:
Ross Valve Mfg. Co., Inc.

Valves, Butterfly, Check, Flap, Foot, Hose, Mud and Plug:
James B. Clow & Sons
M. Greenberg's Sons
Rensselaer Valve Co.
R. D. Wood Co.

Valves, Detector Check:
Hersey Mfg. Co.

Valves, Electrically Operated:
James B. Clow & Sons
Kennedy Valve Mfg. Co.
Philadelphia Gear Works, Inc.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.

Valves, Float:
Ross Valve Mfg. Co., Inc.

Valves, Gate:
Dresser Mfg. Div.
James Jones Co.
Kennedy Valve Mfg. Co.
Ludlow Valve Mfg. Co.
M & H Valve & Fittings Co.
Mueller Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Valves, Hydraulically Operated:
James B. Clow & Sons
Kennedy Valve Mfg. Co.
Philadelphia Gear Works, Inc.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Valves, Large Diameter:
James B. Clow & Sons
Kennedy Valve Mfg. Co.
Ludlow Valve Mfg. Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Valves, Regulating:
Ross Valve Mfg. Co.

Valves, Swing Check:
James B. Clow & Sons
M. Greenberg's Sons
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Waterproofing
Inertol Co., Inc.

Water Softening Plants:
(See Softeners)

Water Supply Contractors:
Layne & Bowler, Inc.

Water Testing Apparatus:
Hellige, Inc.
LaMotte Chemical Products Co.
Photovolt Corp.
Wallace & Tiernan Co., Inc.

Water Treatment Plants:
American Well Works
Chain Belt Co.
Chicago Bridge & Iron Co.
Dorr Co.
Everson Mfg. Corp.
Infilco, Inc.
Pittsburgh-Des Moines Steel Co.
Roberts Filter Mfg. Co.
Walker Process Equipment, Inc.
Wallace & Tiernan Co., Inc.
Welsbach Corp., Ozone Processes Div.

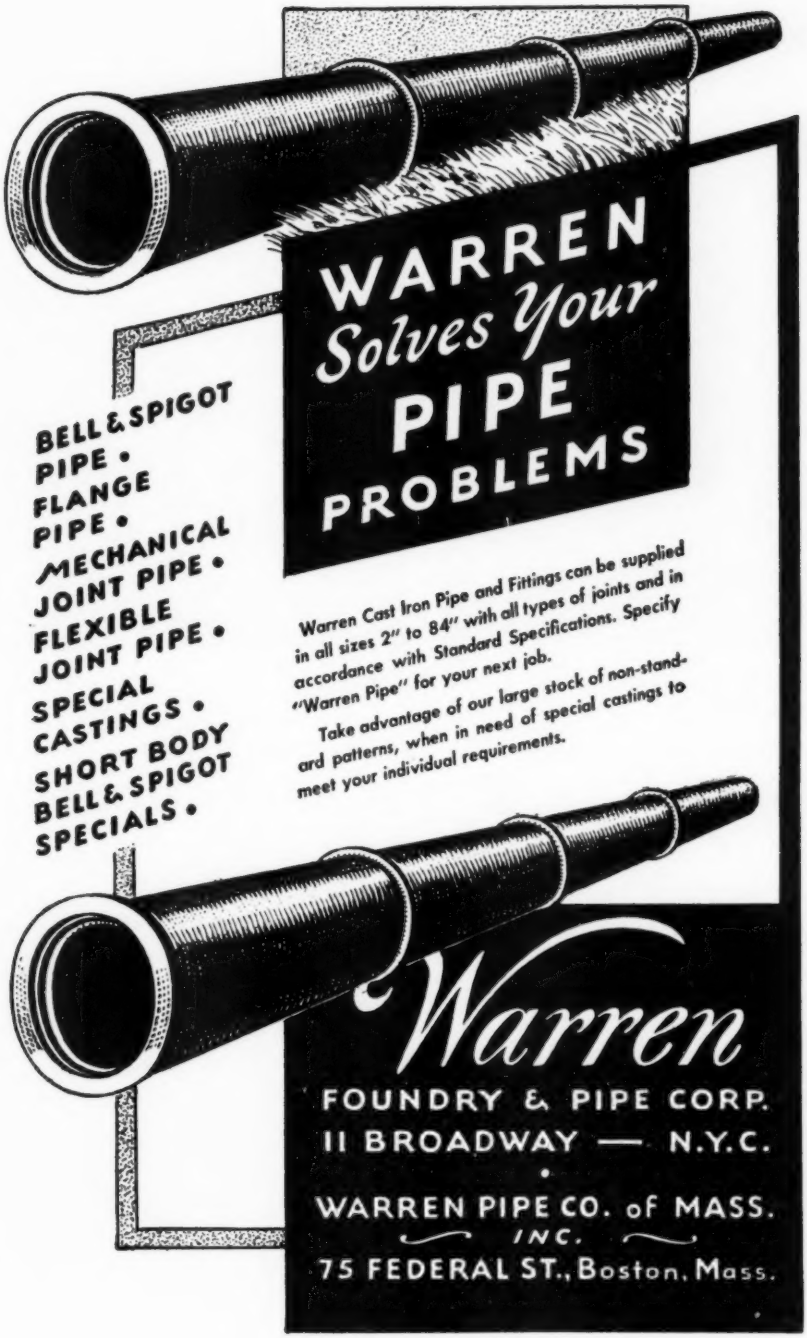
Well Acidizing:
Dowell Incorporated

Well Drilling Contractors:
Layne & Bowler, Inc.

Wrenches, Ratchet:
Dresser Mfg. Div.

Zeolite:
Infilco, Inc.
Permutit Co.
Roberts Filter Mfg. Co.

A complete Buyers' Guide to all water works products and services offered by A.W.W.A. Associate Members appears in the 1948 Membership Directory.


WARREN
Solves Your
PIPE
PROBLEMS
BELL & SPIGOT PIPE •
FLANGE PIPE •
MECHANICAL JOINT PIPE •
FLEXIBLE JOINT PIPE •
SPECIAL CASTINGS •
SHORT BODY BELL & SPIGOT SPECIALS •
Warren Cast Iron Pipe and Fittings can be supplied in all sizes 2" to 84" with all types of joints and in accordance with Standard Specifications. Specify "Warren Pipe" for your next job.
Take advantage of our large stock of non-standard patterns, when in need of special castings to meet your individual requirements.
Warren
FOUNDRY & PIPE CORP.
11 BROADWAY — N.Y.C.
WARREN PIPE CO. of MASS.
INC.
75 FEDERAL ST., Boston, Mass.

The "GREAT GILDERSLEEVE"*
* STARRING HAROLD PEARY . . . ON THE AIR FOR KRAFT FOODS COMPANY OVER N. B. C.
. . . PUTS NEW TWISTS
IN METER READING

Having decided the essential and noble art of meter reading needs glamour, Summerfield's ebullient Water Commissioner Gildersleeve interviews applicants for job of Meter Readerette.

"Summerfield's water sales are dripping . . . I mean dropping. We gotta get behind this drive and create more water demand," says Gildy as he explains duties to newly hired trio.

"This," expounds the Commissioner, "is a Pittsburgh Water meter, a gadget that will charge for every drop of water. Little arrows go round and round and water comes out here."

PITTSBURGH-EMPIRE METERS

PITTSBURGH EQUITABLE METER DIVISION
ROCKWELL MANUFACTURING COMPANY
PITTSBURGH 8 PA.

Atlanta Boston Chicago Houston Kansas City Los Angeles
New York Pittsburgh San Francisco Seattle Tulsa

Seriously speaking, there's nothing that equals the accuracy of Pittsburgh-Empire meters. Use them for profit.

Next month Commissioner Gildersleeve explains the importance of accuracy—

INDUSTRIAL WATER

of the purity you require...

at the price you can pay!

Pictured above is a typical Dorr industrial water treatment plant . . . modern, compact, and efficient. Installed to supply process water at a new 430 ton-per-day pulp mill, it comprises the proven combination of a Dorrco Flocculator with a Dorrco Squarex Clarifier for turbidity removal prior to filtration.

Raw water is dosed with alum, coagulation takes place in a Dorrco Flocculator shown in the foreground, after which the suspended particles are settled and removed by the Dorrco Squarex Clarifier in the background. Both units are built into a single, rectangular structure . . . an economical tank shape for multiple unit installations.

In order to meet every industrial water need economically, The Dorr Company offers a complete line of treatment units. Local conditions, such as raw water supply, volume of flow, and degree of purity required, will determine which is best suited to do your job at top efficiency . . . and at minimum cost.

Write for Bulletin #9141, just off the press, for further information . . . or better still, let an experienced Dorr engineer describe this complete line of equipment in relation to your own problem.

DORRCO

THE DORR COMPANY, ENGINEERS
570 LEXINGTON AVE., NEW YORK 22, N. Y.
ATLANTA • TORONTO • CHICAGO
DENVER • LOS ANGELES
RESEARCH AND TESTING LABORATORIES
WESTPORT, CONN.
SUGAR PROCESSING
PETREE & DORR DIVISION, NEW YORK 22, N. Y.
ASSOCIATES AND REPRESENTATIVES
Dorr Technical Services and Equipment Are Also Available Through Associated Companies and Representatives in the Principal Cities of the World. Names and Addresses on Request.

RESEARCH **DORR** ENGINEERING EQUIPMENT

LEADITE

Trade Mark Registered U.S. Pat. Office

Jointed for . . . Permanence with LEADITE

Generally speaking, most Water Mains are buried beneath the Earth's surface, to be forgotten,—they are to a large extent, laid for permanency. Not only must the pipe itself be dependable and long lived,—but the joints also must be tight, flexible, and long lived,—else leaky joints are apt to cause the great expense of digging up well-paved streets, beautiful parks and estates, etc.

Thus the "jointing material" used for bell and spigot Water Mains MUST BE GOOD,—MUST BE DEPENDABLE,—and that is just why so many Engineers, Water Works Men and Contractors aim to PLAY ABSOLUTELY SAFE, by specifying and using LEADITE.

Time has proven that LEADITE not only makes a tight durable joint,—but that it improves with age.

The pioneer self-caulking material for c. i. pipe.
Tested and used for over 40 years.
Saves at least 75%

THE LEADITE COMPANY
Girard Trust Co. Bldg. Philadelphia, Pa.

No Caulking